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MACHINERY

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The Monthly Magazine of Engineering and Production in the Manufacture of Metal Products

SHOP PRACTICE

MACHINE AND TOOL DESIGN

MANAGEMENT PROBLEMS

DEPARTMENTS

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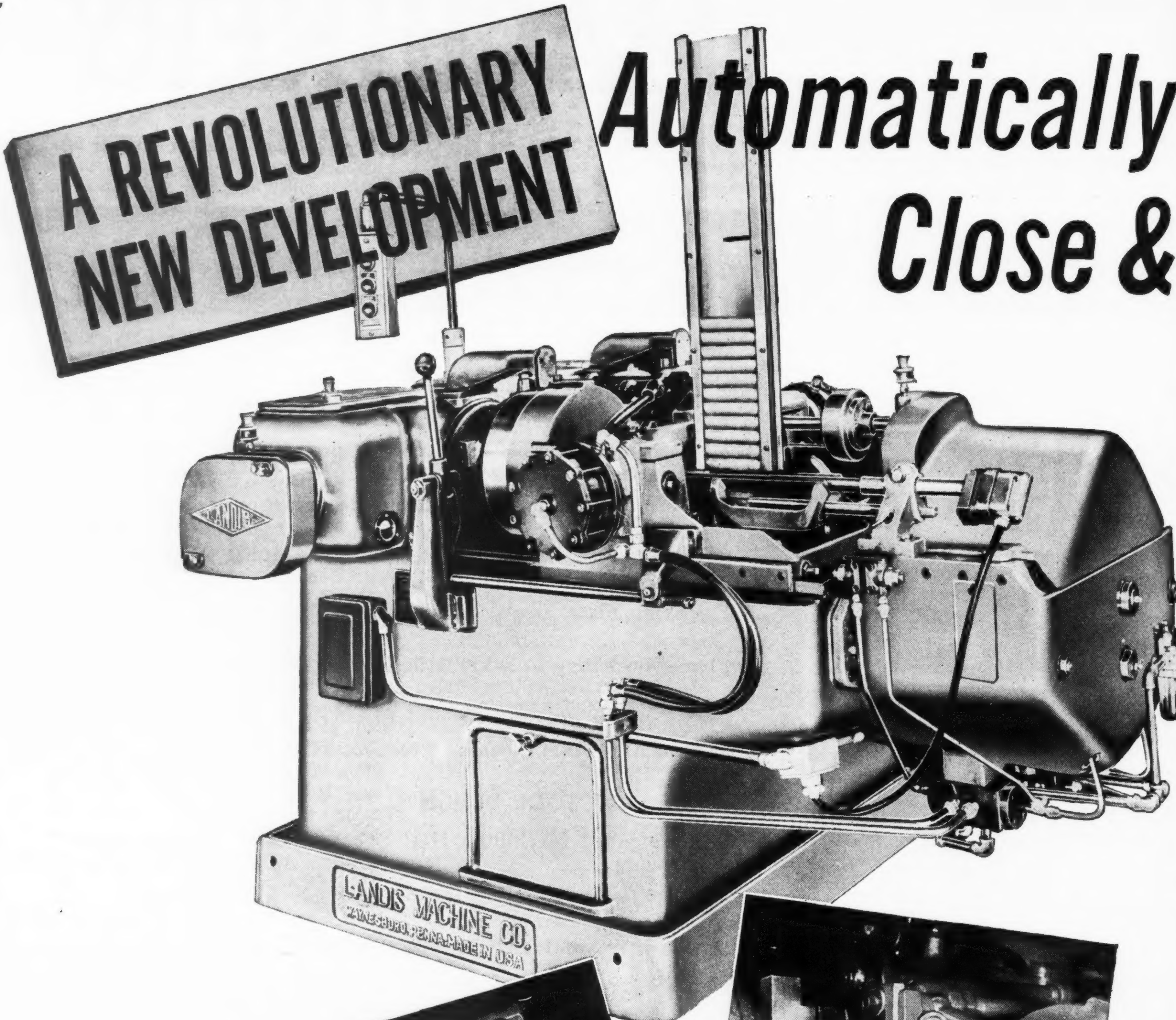

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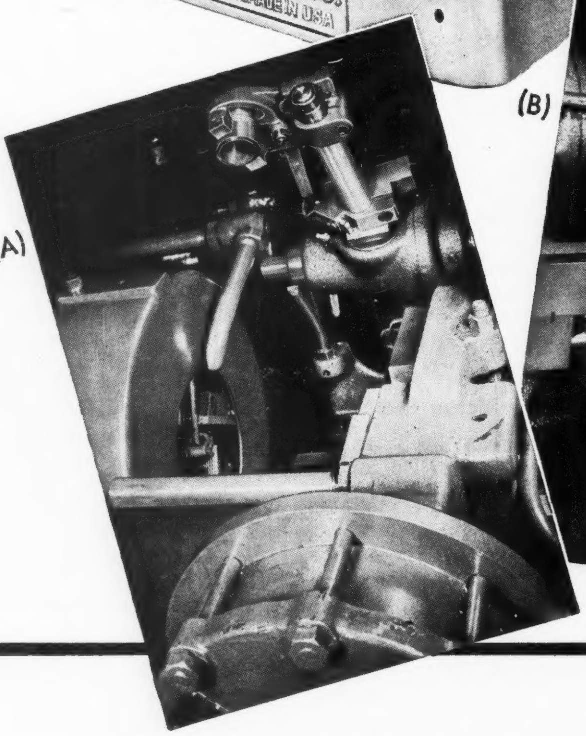

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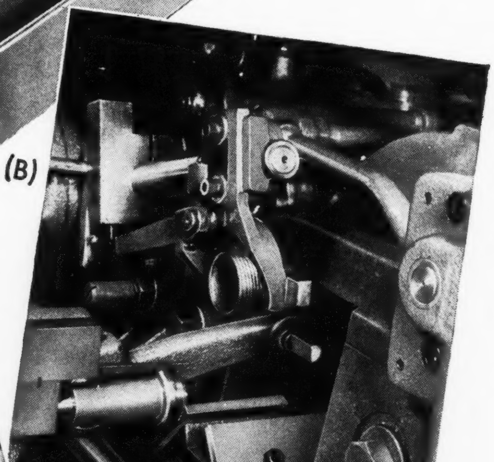


The LANDIS Machine

Priorities for Machine Builders are a Stern Necessity

THE machine tool industry in 1950 turned out products having a total value of approximately $300,000,000. This year its output should range between $500,000,000 and $600,000,000. Even with such an expanded production, executives of the National Production Authority and representatives of the machine tool industry have estimated that the capacity of the industry will be about 25 per cent less than the anticipated needs of the present national emergency.

For this reason, it is imperative that the builders of machine tools and all other types of metal-working equipment be given preferred consideration in their efforts to obtain steel, castings, motors, electrical control units, and other materials or parts. Moreover, these items should be supplied in sufficient quantities to permit the building of machines in suitable lots, and not doled out piecemeal as if all machines had to be built one at a time.

As it is now, some machine tool builders have their assembly floors tied up with machines ready for shipment except that one lacks a control panel, another a limit switch, a third a pump, a fourth a gearbox cover, and so on. This is a serious situation, with the unfilled orders of the machine tool industry over twelve times the monthly production.

During World War II, the backlog of orders for machine tools never exceeded 7.2 times the monthly production. This was due to the excellent cooperation extended by the War Production Board, as a result of which the machine tool industry was able to expand its capacity in keeping with the gradual increase in demands. The industry was never very far behind in its job of tooling for the waging of a successful war.

If the Armed Services are to have ammunition, guns, aircraft, vehicles, and other fighting equipment delivered to them according to schedules, it is up to the National Production Authority to give the builders of machine tools and other metal-working machinery greater consideration than that extended to manufacturers of household appliances and other civilian goods. One of the first steps of the Government before World War I and World War II was to give top ranking priorities to machine tool builders—a policy that enabled the industry to perform production miracles.

It is only through the use of machine tools and other metal-working equipment and cutters that a modern army can be supplied with the sinews of war. This is a precept to be remembered constantly by those responsible for keeping our fighting men adequately prepared for potentialities. Priorities are certain to be established for the machine tool industry. The sooner this is done, the more effective will be our national defense efforts.

Charles O. Herb

EDITOR

MACHINERY

Vol. 57 FEBRUARY, 1951 No. 6

HIGH-SPEED MACHINING OF FORGINGS

Cutting Speeds as High as 1130 Surface Feet per Minute are being Employed by the Ford Motor Co. in Turning Forged Gear Blanks. Two Pounds of Metal are Removed from One Part in Twelve Seconds

By CHARLES H. WICK

SOME interesting developments in increasing production rates have been made by the Ford Motor Co.'s production men, aided by research and development technicians. High-speed machining of forged gear blanks, for example, has increased production rates of these parts considerably. Quality of the machined parts has also been improved by the methods used, and the cost has been substantially reduced. Powerful machines, especially designed to take full advantage of multiple carbide tools, are employed, permitting cutting speeds as high as 1130 surface feet per minute. Approximately 2 pounds of metal are removed from one forged gear blank in a twelve-second cutting cycle.

Such high cutting speeds and rapid stock removal rates are aided considerably by carefully controlling the time and temperature during annealing of the blanks, directly following the forging operation. As a result of this close control of annealing or normalizing, the forgings have a uniform hardness and structure, a grain size of from 4 to 6, and a stress relieved, pearlitic blocky type of structure with the required machining qualities.

Rear-axle driving pinions are forged from S A E 4028 steel on an upsetter. After annealing at a temperature of 1190 degrees F., the forgings have a Brinell hardness of about 160. The parts are straddle-milled to length and centered on

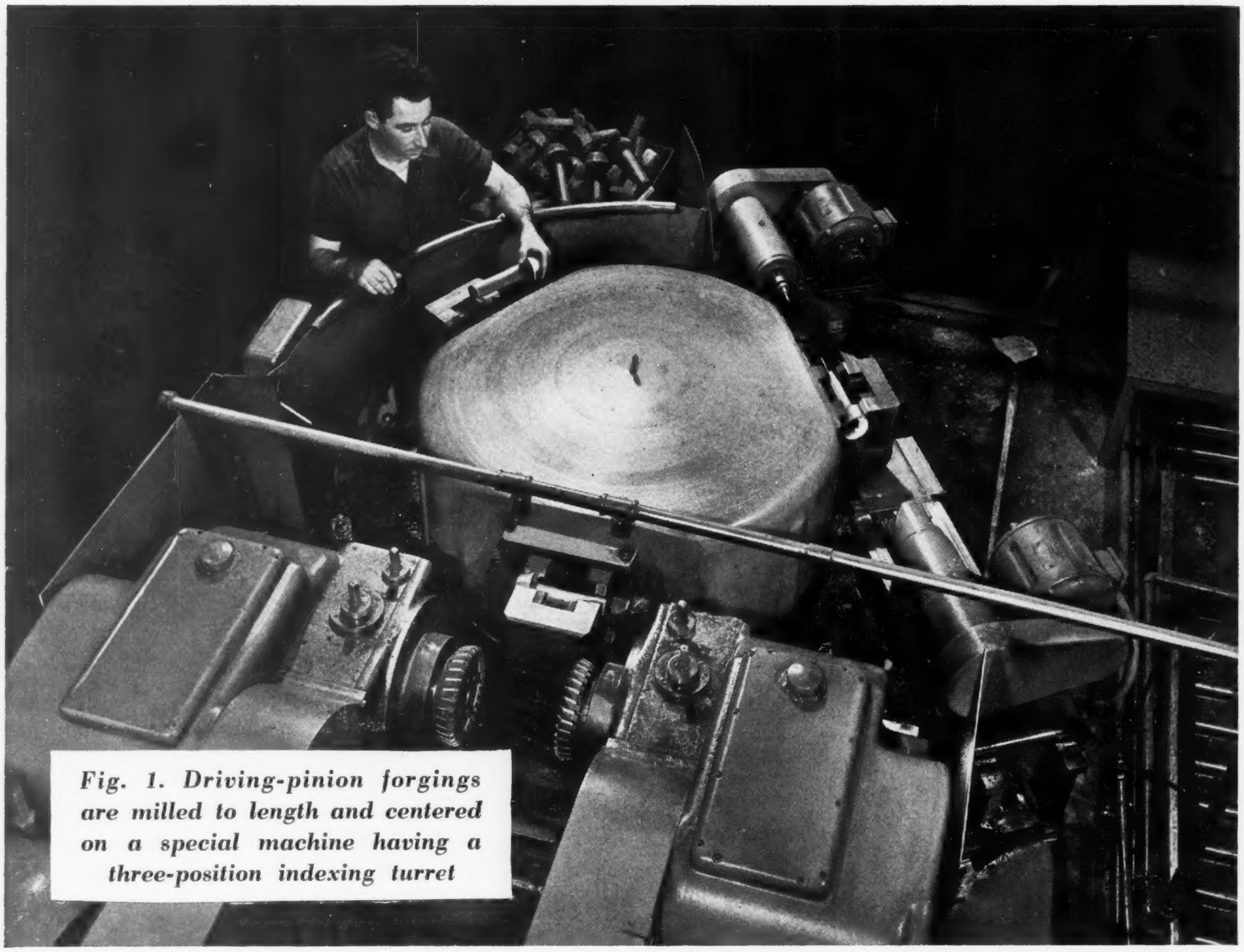


Fig. 1. *Driving-pinion forgings are milled to length and centered on a special machine having a three-position indexing turret*

both ends on a special machine, Fig. 1, made by the Motch & Merryweather Machinery Co. A three-position indexing turret is provided, so that a forging can be loaded at one station while one is being milled at the second station and another center-drilled at the third station.

After a milled and centered part has been unloaded, a rough forging is placed in the jaws at the loading station and indexed to a position in front of the straddle milling cutters. These shell end-mills, which are 8 inches in diameter and provided with inserted carbide teeth, are rotated at 170 R.P.M. (356 surface feet per minute) and fed hydraulically past the forging to give a chip load of 0.009 inch per tooth. From 0.035 to 0.105 inch of stock is removed from each end of the forging.

When the faced part has been indexed to the next station, the two drills are advanced to center both ends of the shaft simultaneously. The center drills are rotated at 800 R.P.M. (80 surface feet per minute), and fed 0.004 inch per revolution. Floor-to-floor time is 18 1/2 seconds per forging, resulting in a net production of 155 driving pinions per hour with 80 per cent efficiency. The machine and work-holding jaws are of flexible design, so that two different size forgings can be faced and centered on the same machine with a minimum change in set-up.

All the turning required on the multiple-diameter driving pinions is completed in one operation, the parts being faced, chamfered, and formed on the 50-H.P. Fay single-spindle automatic lathe seen in the heading illustration and in Fig. 2. About 2 pounds of metal are removed from each forging in a twelve-second cutting cycle. The work is rotated at 1200 R.P.M., which is equivalent to a cutting speed of 1130 surface feet per minute on the maximum diameter of the part.

With the forging centered on the headstock spindle, a push-button is depressed to advance the tailstock. The tailstock exerts an initial pressure of 14,000 pounds on the part to force five tungsten-carbide driving prongs, mounted on the headstock spindle, into one face of the forging. The triangular-shaped carbide prongs are brazed to a tool-holder, which is bolted to the spindle. Pressure exerted on the work by the tailstock is reduced to 1200 pounds during machining. The tailstock ram is 6 inches in diameter, and rotates on anti-friction bearings.

Plexiglas covers automatically slide into position and enclose the top of the machine at the

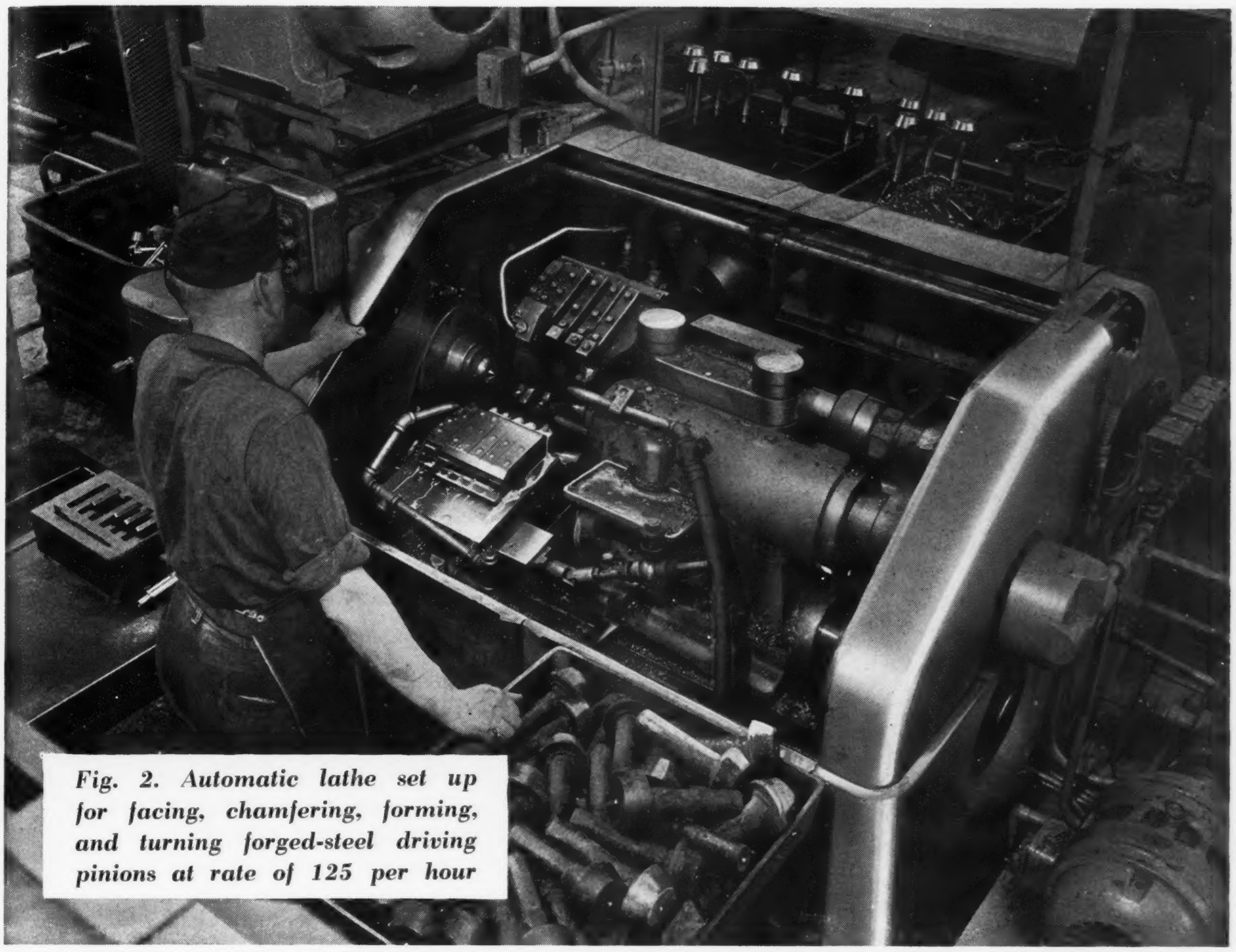


Fig. 2. Automatic lathe set up for facing, chamfering, forming, and turning forged-steel driving pinions at rate of 125 per hour

beginning of the machining cycle. A pressure regulator provides for stopping the machine automatically in case the covers contact the operator's arm or other obstruction while sliding into position.

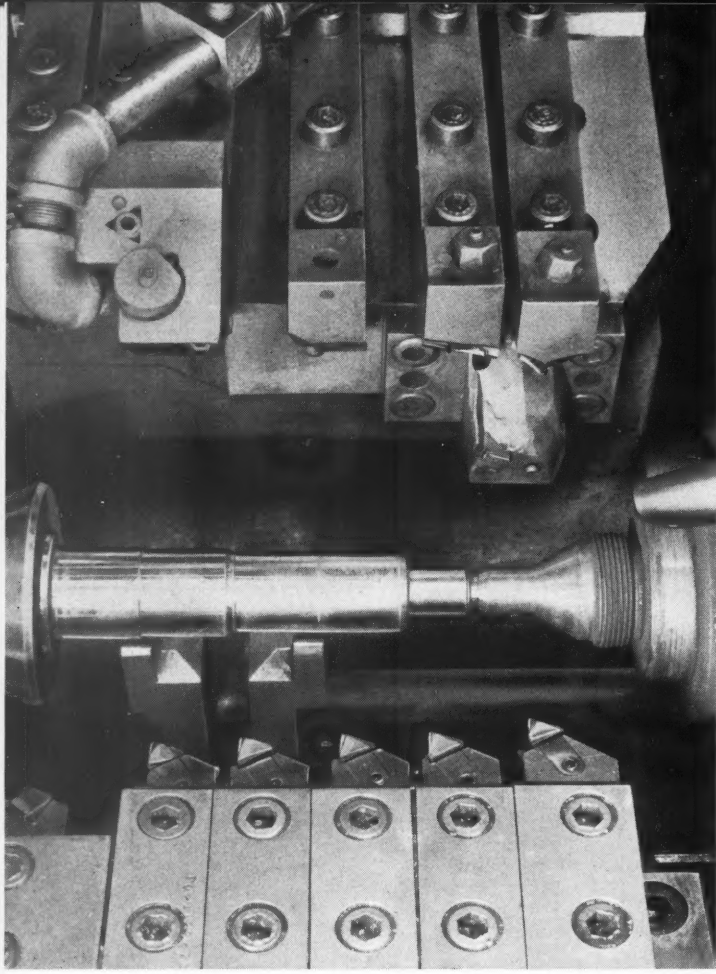
The lathe is equipped with thirteen solid carbide tools, Fig. 3, which are held mechanically in steel tool-holders. Seven of the tools are triangular, four are square, and two are specially shaped for forming. The triangular and square tools can be indexed in their holders when the cutting edges become dull, thus presenting sharp edges to the work. When the three or four edges on each tool become dull, the tool can be inverted in its holder without changing the set-up. In this way, from six to eight cutting edges can be used before sharpening becomes necessary. The average tool life varies from 150 to 1200 pieces per grind.

The stock removed from different surfaces varies up to a maximum of 3/8 inch per side on the small-diameter end of the pinion forging shank. Turning tools are fed at the rate of 0.014 inch per revolution, and facing tools at 0.012 inch per revolution. Floor-to-floor time is 25 seconds, resulting in a net production of 125 forgings per hour.

A water-soluble cutting fluid is flooded on the part and on the tools to cool them and also to flush away the chips. The two bearing diameters on the shank of the driving pinion are held to a tolerance of ± 0.0025 inch for subsequent grinding, while all other dimensions are maintained within ± 0.005 inch. The bearing surfaces must be concentric within 0.0005 inch total indicator reading.

Production from two of the Motch & Merryweather machines and two of the Jones & Lamson Fay automatics exceeds that previously obtained from ten multiple-spindle vertical lathes. Less maintenance and floor space are required, fewer tools are necessary, and manpower is substantially reduced. Scrap and parts requiring reworking have decreased, and the accuracy and surface finish of the machined forging are considerably improved. The dimensions of a finish-machined driving pinion (with the required tolerances) are shown superimposed on those of a rough forging in Fig. 4.

Hypoid driving-gear blanks press-forged from S A E 8620 and S A E 4028 steel are also annealed at 1190 degrees F. to relieve the stresses set up during forging. After annealing, the parts have a Brinell hardness of about 160. All sur-



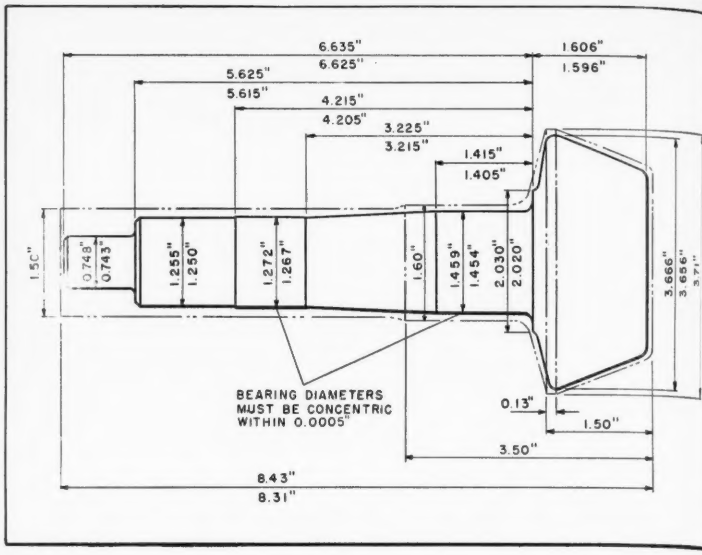


Fig. 3. (Left) Close-up view of the tooling area on the automatic lathe seen in heading illustration and in Fig. 2. Thirteen carbide tools remove 2 pounds of metal in twelve seconds

Fig. 4. (Above) Comparative dimensions of a rough-forged and finish-machined driving pinion. All the machining is completed on two machines

faces of the driving-gear forgings except the back face are finish-machined in two operations, Fig. 7, on 50-H.P. hydraulic lathes made by the Morey Machinery Co. The forgings are securely held in three-jaw hydraulic chucks, and rotated at 500 R.P.M. This provides a cutting speed of 1050 surface feet per minute when machining the maximum diameter on the periphery of the part.

In the first operation, Fig. 5, the gear blank is chucked on its periphery and beveled face. Four carbide-tipped tools, grouped together, are fed outward hydraulically at the rate of 0.014 inch per revolution to completely form the bore of the driving gear. From 1/16 to 1/2 inch of stock is removed on the diameters, and a tolerance of 0.001 inch is maintained on the smallest bore.

Simultaneously, a triangular-shaped carbide tip, mechanically held in a steel shank, is fed across the flat back face of the forging at the rate of 0.014 inch per revolution. Approximately 3/32 inch of stock is removed from this face in one pass. The boring and facing operations are completed in 19 seconds. The floor-to-floor time is 30 seconds, resulting in a net production of 70 parts per hour at 80 per cent efficiency.

For the second operation, Fig. 6, the position of the work in the chuck is reversed. The machined bore of the forging is chucked on a solid adapter having hydraulically actuated plunger fingers. Five carbide tools are employed to turn the periphery and beveled face of the gear blank, chamfer the bore, and blend the outside corners. The turning tools are triangular-shaped carbide bits, while the chamfering and blending tools are square. The periphery turning tool and the facing tool are fed at 0.014 inch per revolution. Actual cutting time is 19 seconds, and floor-to-floor time is 27 seconds. All of the tools are fed hydraulically.

Four of these hydraulic lathes, two for the first operation and two for the second operation, give the same production as that previously obtained from ten multiple-spindle vertical lathes. About 2 1/4 pounds of metal are removed from each forging in the two operations.

The bore must be concentric relative to the periphery of the finish-machined blank within 0.002 inch. Runout of the back face must not exceed 0.002 inch when checked with relation to the bore and pitch line of the gear. The face angle of the beveled edge must be within 8 minutes of the desired angle. It has been found impossible to hold the back face of the blanks flat within 0.001 inch, as required, because of the inherent stresses in the forging that are relieved during machining. A subsequent finishing cut is, therefore, necessary, in which about 0.010 inch of stock is removed from the back face.

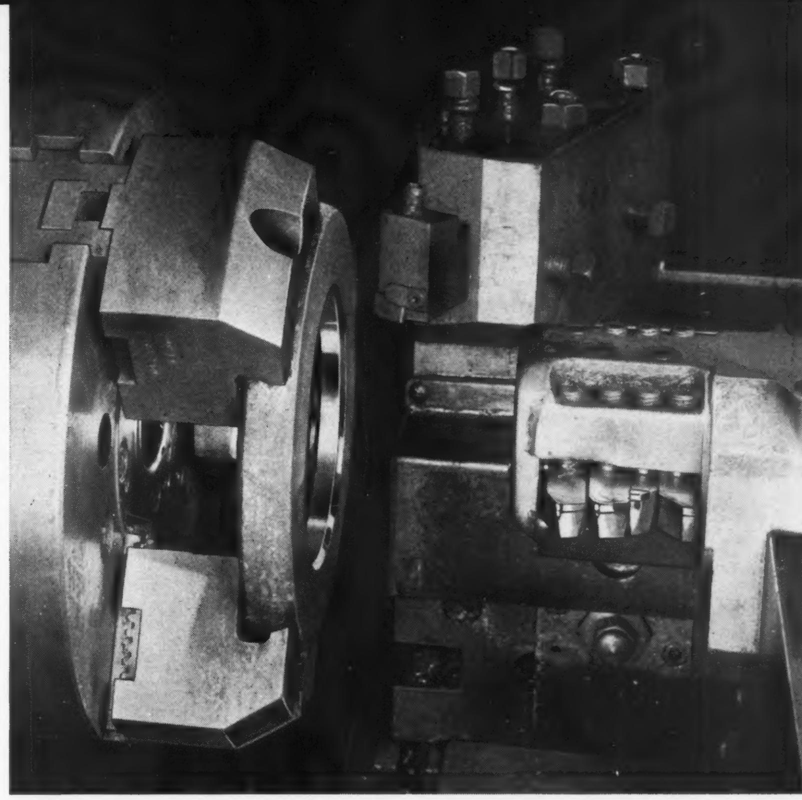


Fig. 5. One face and the formed bore of the driving-gear forging are finish-machined in a thirty-second floor-to-floor cycle

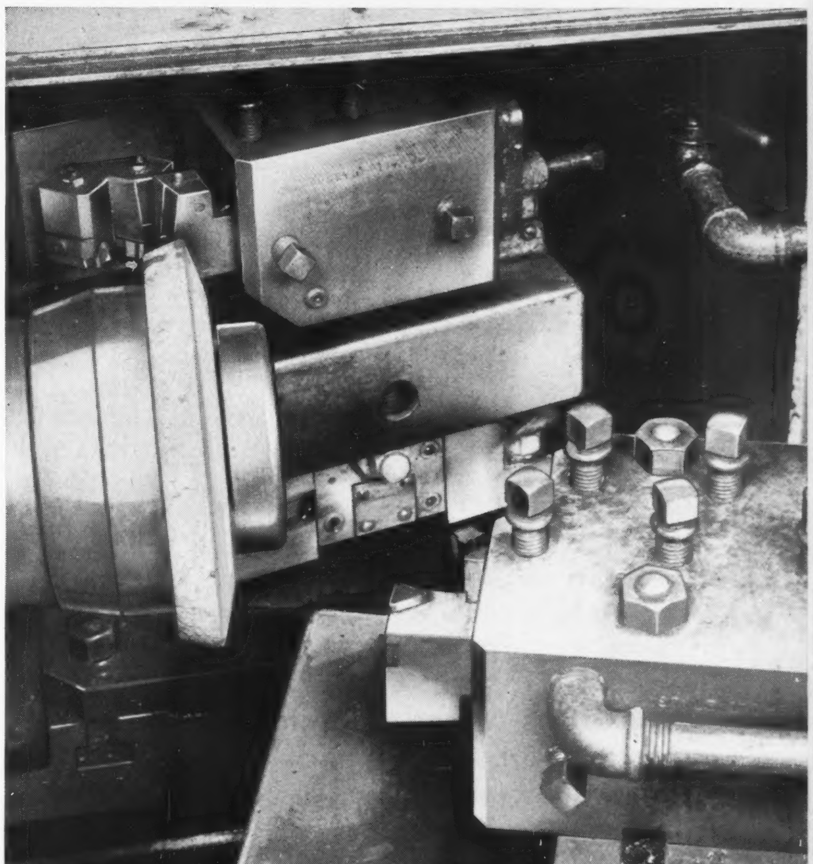
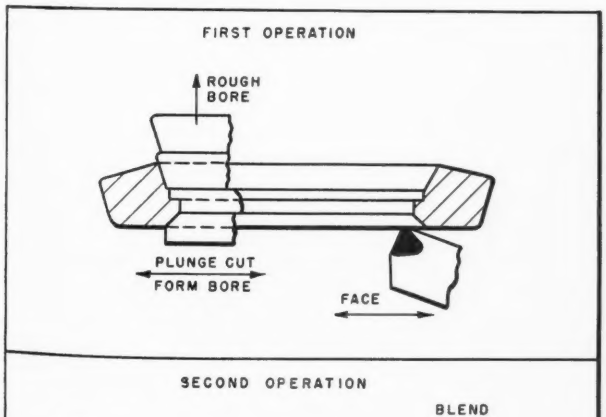


Fig. 6. In the second operation performed on the forged driving gear, the periphery, beveled face, chamfer, and outside corners are machined

Fig. 7. All surfaces of forged driving-gear blanks except the back face are finish-machined in two operations with the set-ups shown in Figs. 5 and 6



Designing and Machining High-Speed Mixed-Flow Compressor Impellers

By
HAROLD WOODHOUSE

Development of an Impeller that Compresses Gases with a Minimum of Turbulence, and Machining Set-Up Used to Produce It

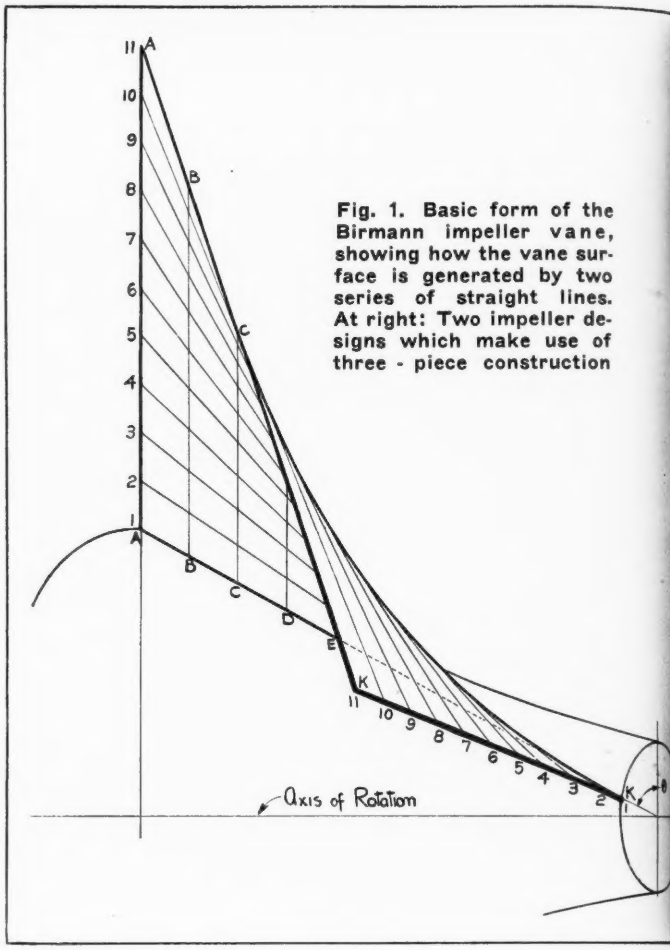


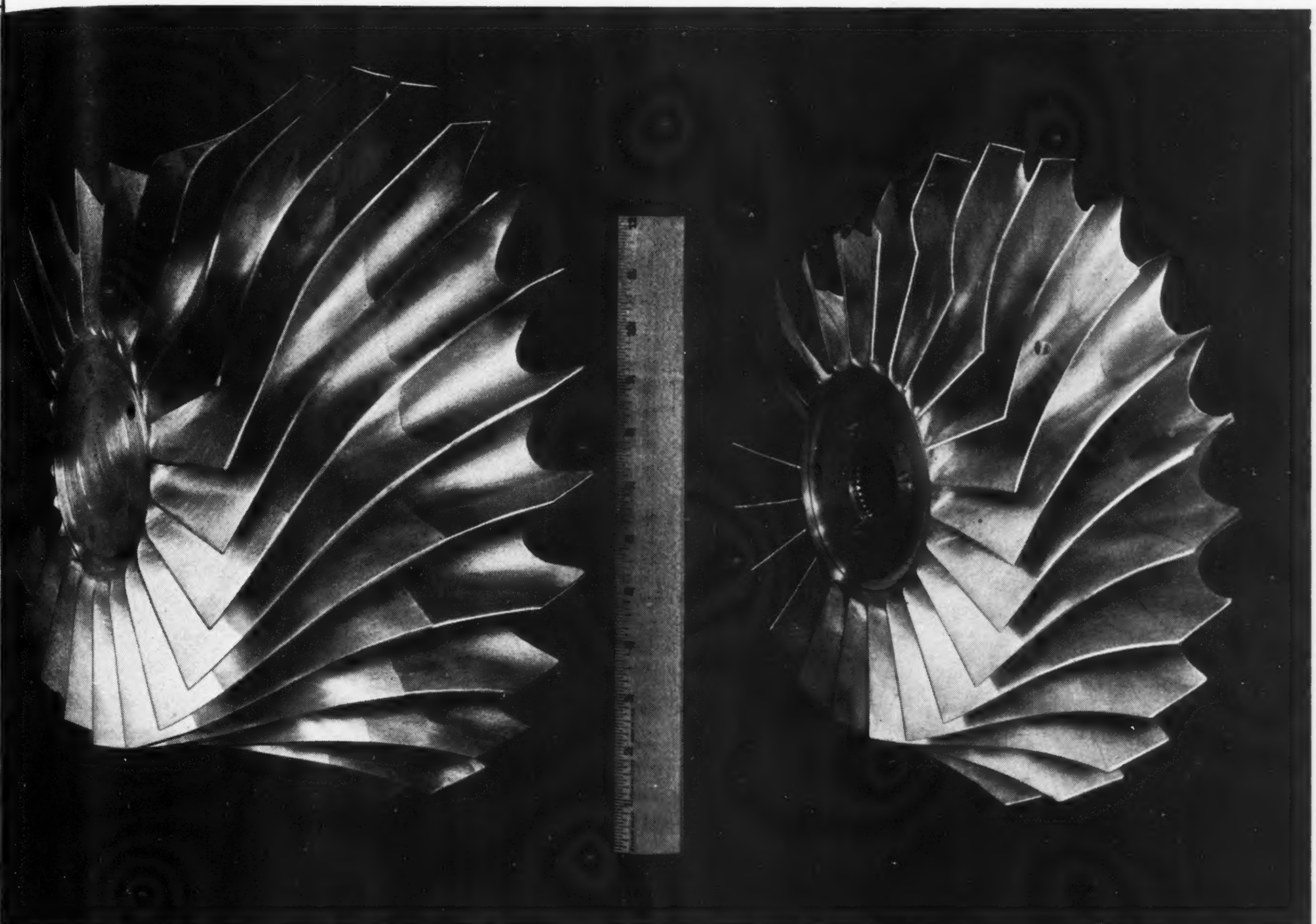
Fig. 1. Basic form of the Birmann impeller vane, showing how the vane surface is generated by two series of straight lines. At right: Two impeller designs which make use of three - piece construction

TO compress air or other gases efficiently, the process of compression should, as far as possible, be one that does not cause turbulence in the gas being compressed. When turbulence occurs, an undesirable temperature rise takes place. The work required to cause this temperature rise must be performed by the compressor (a condition that reduces the amount of work available for the actual compression of the gas), thereby decreasing the efficiency of the operation.

The problem of efficient compression, therefore, becomes one of getting the air into, through, and out of the compressor with the least possible disturbance of the gas. In the Birmann mixed-flow impeller, the disturbance is minimized by having the flow follow a straight line as nearly as possible during the process of centrifugal compression.

Development of the Impeller Vane Profile

The basic form of impeller vane that accomplishes the compression with minimum disturbance is shown in Fig. 1. The surface of the vane is the locus of the points of intersection of two series of straight lines. The first series of lines,



AA, BB, . . . KK, are all radial, and are angularly displaced in relation to one another, as shown in the diagram. The angular displacement of the first radial line *AA* from the last radial line *KK* is shown as the angle θ. The choice of angle θ has been shown by tests to influence the performance of the impeller, and in the Birmann impeller this angle is larger than that used in other designs.

The second series of straight lines, 1, 2 . . . 11, all lie in parallel planes; however, the angular direction of these lines within their planes varies from one parallel plane to another. The path of the air flow through the impeller may be said to be substantially along this second set of straight lines. This straight-line path of flow minimizes disturbances to the air flow, a major objective of the original design.

Another design objective requires that, in any plane at right angles to the axis of rotation, the vane profile be a radial line. This is essential for high-speed supercharger, gas-turbine, or jet-engine impellers that have an operational tip speed of 1200 to 1900 feet per second, as bending stresses in a non-radial vane would result in failure of the vane material. Passing such a plane through the vane and hub shown in Fig. 1 so as to intersect the hub at point *B* on the base of the vane, the radial line *BB* would be the profile of the vane in that plane, and if the complete impeller had twenty-three vanes, the cross-sectional picture would consist of a circular hub with twenty-three such radial spokes.

To present as clearly as possible the basic concept of straight-line construction, the two series of straight lines are further illustrated by the mechanical drawing lay-out, Fig. 2. In view *a*, the series of radial lines is shown by lines *0a, 0b . . . 0k,* and the series of straight lines in parallel planes by 1, 2 . . . 11. The outline of a vane that could be obtained from this theoretical construction is indicated by *ABCD*. The flow path of the air through this impeller vane would be substantially along lines 1, 2, . . . 11. The variation in angle from plane to plane in the second series of straight lines is shown by lines 1 . . 6 . . 11 in view *b*, Fig. 2.

View *c* shows the cross-section of an impeller having the vane surface just described. All points on the vane surface, which, as seen in Fig. 1, is a warped surface, are rotated into the plane of the paper, which represents a radial plane passing through the points *A* and *B* in view *a*, Fig. 2. This results, for instance, in the portions *AD* and *BC* of straight lines 1 and 11,

view a, appearing as the curved lines $A'D'$ and $B'C'$ in view c. The path of a particle of air traveling along, say, line 6 in view a would appear to travel in a curved path when projected into view c, as shown by line 6.

The appearance of the vane when viewed from the vane-tip periphery of the impeller is as shown in view d. The angle θ referred to in Fig. 1 is again shown as being the projected periphery of the angular span of one vane.

Lay-Out of the Machining Set-Up

In the lay-out of an actual machining set-up, the lines 1, 2 . . . 11 in views a and b, Fig. 2, represent the center lines of the generating milling cutter in its several positions. View a shows the positions 1, 2 . . . 11 in parallel planes, and view b shows the variation of angle from β_1 to β_{11} in those parallel planes.

It might also be noted that, for lay-out purposes, it is easier to depict the impeller as stationary and the cutter as swinging through angles β_1 to β_{11} while generating the vane. All lay-outs have been made in this manner. In the machining set-up, the cutter center line remains fixed while the impeller blank swings through angles β_1 to β_{11}.

Plane a in Fig. 2 represents the inlet face of the impeller and plane k the edge of the vane in what is called the back face of the impeller.

To generate the vane so that its surface is formed by two series of straight lines, as previously described, it is necessary for the generating cutter or tool to maintain the following mathematical relationship:

Let d_6 (view a, Fig. 2) be an instantaneous distance of the center line of the generating cutter from the axis of rotation of the impeller, and β_6 (view b) the corresponding instantaneous angle which the center line of the generating tool makes with the inlet face of the impeller. Then

$$d_6 \times \tan \beta_6 = \text{a constant } K \qquad (1)$$

and if the generating set-up is such that

$$d_1 \times \tan \beta_1 = d_2 \times \tan \beta_2 = d_n \times \tan \beta_n = K \quad (2)$$

then the required surface will automatically be generated.

The required value of K may be approximated for lay-out purposes as follows: If the inlet eye diameter B', view c, is 11.000 inches, the position of the center line of the cutter when generating this portion of the vane will be line 11 (view a), and the value of d_{11} will be 5.500 inches. Further,

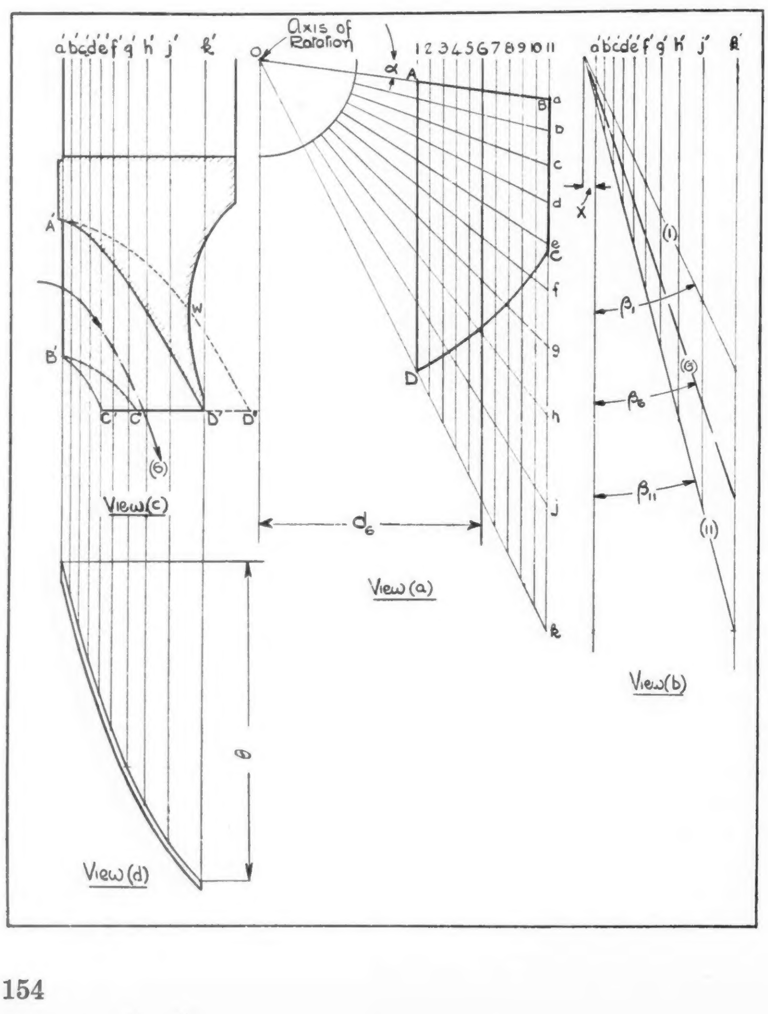


Fig. 2. Development of vane profile seen in Fig. 1, which is generated by straight-line construction

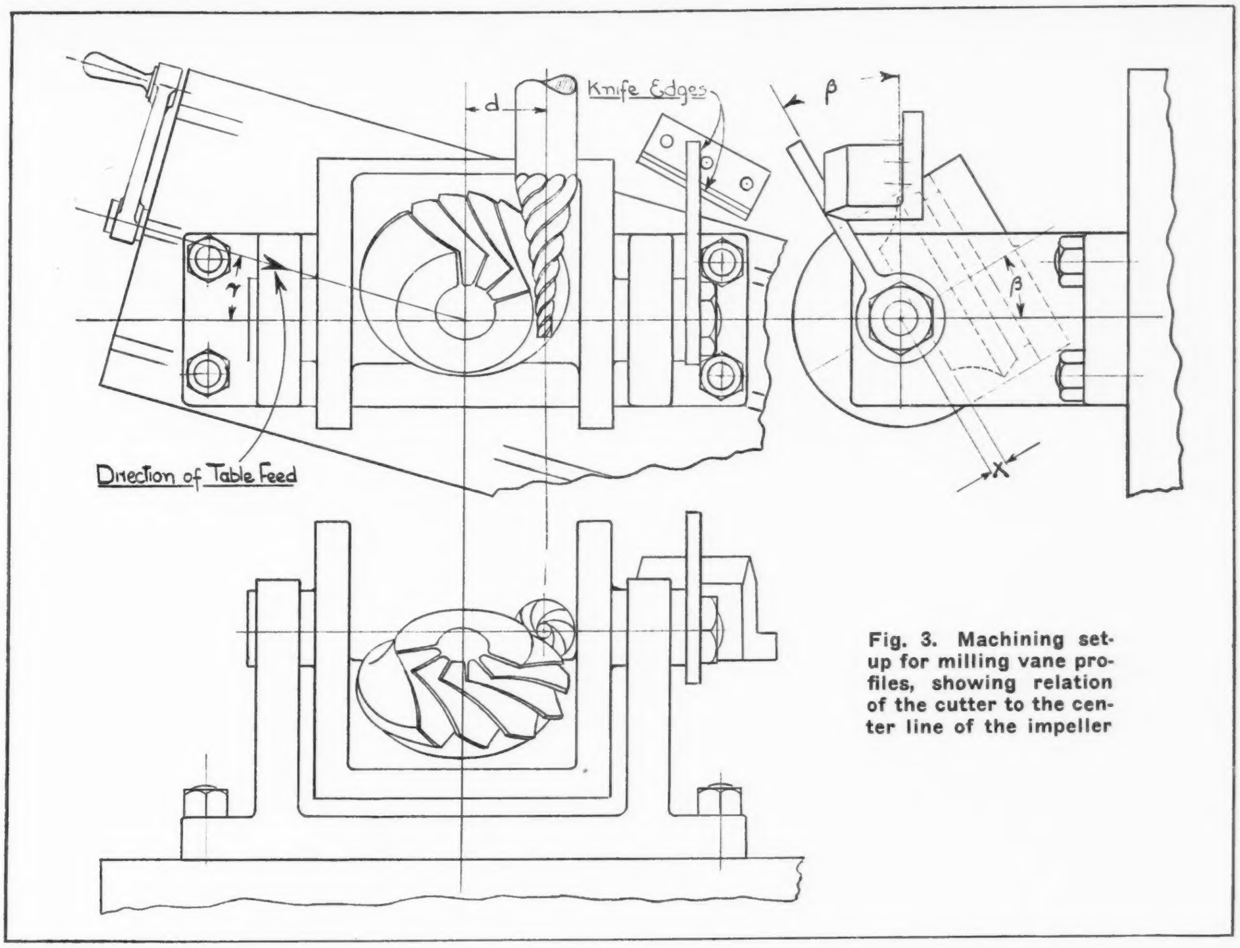


Fig. 3. Machining set-up for milling vane profiles, showing relation of the cutter to the center line of the impeller

if the inlet vane angle required is 30 degrees, the value of β_{11}, view *b*, will also be 30 degrees, so that

$$d_{11} \times \tan \beta_{11} = 5.500 \times \tan 30 \text{ degrees} = 9.526$$

The required conditions to maintain the constant value of K are met by the arrangement shown in Fig. 3. The impeller blank is mounted in a freely swinging cradle, the movement of which is controlled by two knife-edges. If the angle between the two knife-edges is adjusted so that the condition

$$d_n \times \tan \beta_n = K$$

is fulfilled for any two values of d and β, the condition will be fulfilled for any position within the limits of travel of the machine.

The effect of changing the angle γ at which the blank is fed into the cutter is to vary the amount of taper produced in the vane from its root at the hub to its tip at the periphery. With the cutter fed into the blank to its maximum depth, and with all points along the cutter profile brought into the plane of the paper, as described for the projection of the vane, the cutter will appear as shown in view *a*, Fig. 4. This diagram illustrates a major difficulty in connection with the machining of this type of impeller.

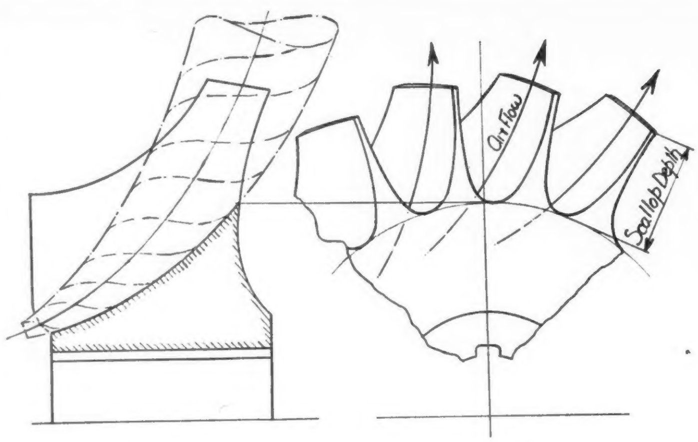
Size and Shape of Cutting Tool Used

The cutter is seen to be of tapered section. The large end is generally over 2 inches in diameter, which lends itself well to making that the driving end with a No. 11 B & S taper shank. The small end is 3/16 inch in diameter, or slightly less. If the diameter of the small end is made larger, it would be necessary to use a smaller number of vanes on the impeller, and since the aerodynamic efficiency of the impeller is roughly proportional to the number of vanes, this would be undesirable.

The standard number of vanes is twenty-three, which has the theoretical advantage (not fully proved in practice) of being a prime number. This number of vanes is less likely to set up vibrations when the air stream hits the diffuser vanes than if there were a common factor between the number of impeller vanes and the number of diffuser vanes.

Feeds and Speeds for Machining

Since compressor impellers—excluding a few inlet inducer sections made of steel—are almost invariably made from aluminum, which is sensitive to deviations from correct cutting condi-



View (a) FIGURE 4 View (b)

Fig. 4. View (a) Positions assumed by the cutter during the machining of a vane profile. View (b) Scallops formed at the back face of the impeller by the large diameter of the cutter

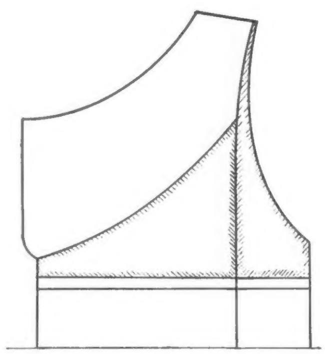


FIGURE 5

Fig. 5. Two-piece construction which is used to close up scallops shown in view (b), Fig. 4

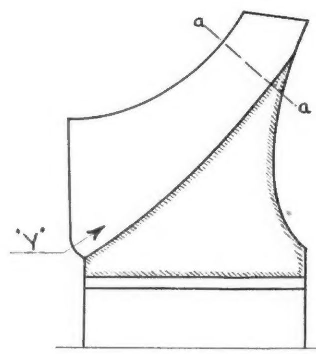


FIGURE 6

Fig. 6. Section through impeller, showing the undesirable narrowing of the air flow path caused by the steep slope of the vane root

tions, it will be seen that a cutter having diameters ranging from 3/16 inch to 2 inches can only be cutting at the right surface speed, for the feed being employed, at one short section of its length.

While aluminum can be machined with heavy cuts and high feeds when conditions are correct, it can, in other circumstances, cause more cutter havoc than is ordinarily met with in machining the high-temperature alloy steels containing tungsten, molybdenum, and vanadium and having work-hardening characteristics. In this case, it has been found that if a cutter speed of 400 R.P.M. with a feed of 1/4 to 1/2 inch per minute is seriously departed from, cutter failure will quickly occur. This represents a feeding rate of 0.00015 to 0.0003 inch, which is ridiculously low according to standard aluminum cutting practice.

Two other conditions contribute to the unnatural reaction of this set-up to normal cutting speeds and feeds: First, owing to the necessity of having a swinging cradle, it is impossible to provide a sufficiently rigid support to the work to eliminate chatter. One might ask why not substitute a cam action for the swinging cradle? The answer is that where it is desirable to be able to cut many different vane contours and angles and to make slight set-up changes as dictated by experience, the swinging cradle presents the most flexible arrangement. Under conditions of a rigidly frozen design, it is always possible to make a single-purpose machine, but except for requirements of high production such an approach is prohibitively expensive.

Second, if we consider the expression

$$d_n \times \tan \beta_n = K$$

it is seen that when d_n is small tan β_n must be correspondingly larger. This means, in effect, that when the cutter is taking its maximum cut as dimension d_n approaches its minimum value (since the cutter will then be most deeply buried in the blank), the rate at which the work is being twisted against the cutter approaches a maximum, since the rate of change of angle β_n is also approaching a maximum.

Referring again to view *a*, Fig. 2, it will be seen that strict adherence to a straight-line vane root and tip, as shown by lines *AD* and *BC*, de-

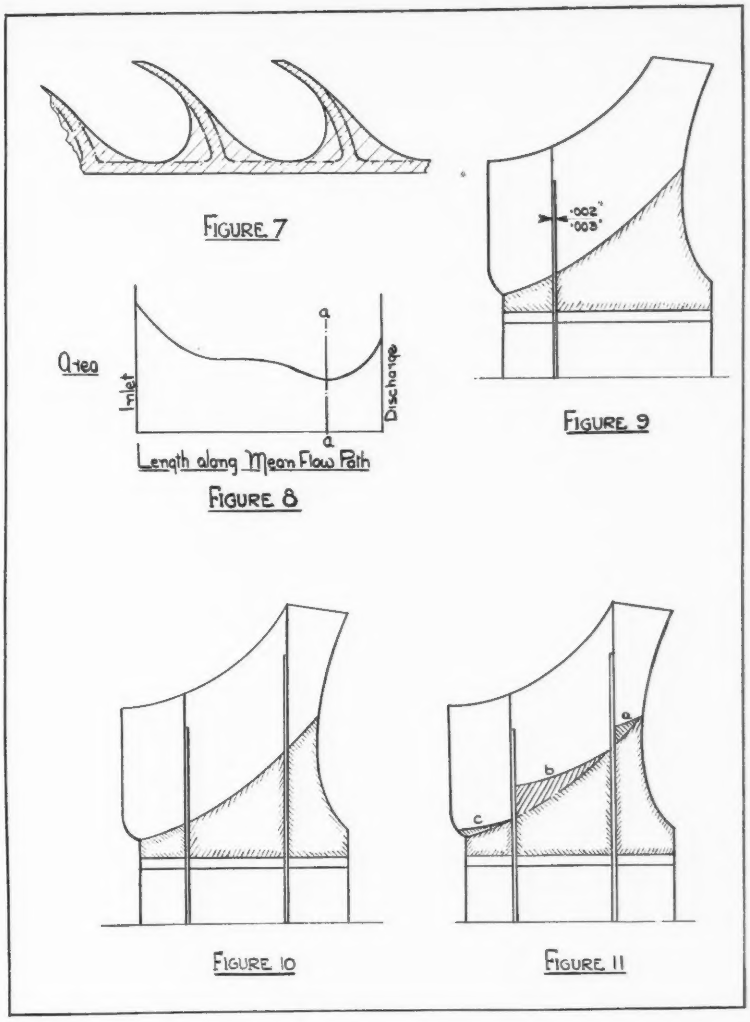
Fig. 7. Cross-section through (a-a), Fig. 6, showing restriction of air flow caused by the fillets left by the large end of the cutter

Fig. 8. Plot of cross-sectional area of flow path against length along mean flow path

Fig. 9. Impeller design in which the inlet portion is made of a separate piece, so that vibrations are effectively damped out

Fig. 10. Impeller design in which both inlet and outlet portions are made of separate pieces

Fig. 11. The shaded areas show excess material which must be removed in subsequent operations when three-piece construction is used



velops the flow path as shown by the cross-section through the vanes $A'B'C'D'$ in view *c*. This would not be a desirable shape in practice for two reasons. The first is that better efficiency is attained if the air is accelerated through the impeller, so that it discharges at a higher velocity than that at which it enters the impeller, this requiring a relatively smaller discharge area.

The second reason is that a more gradual change of direction is desirable at the vane tip than is given by the projection of a straight-line flow vane-tip contour. By changing the vane-tip contour from $B'C'$ to the dotted line $B'C''$, these two objectives would be attained if the vane root line AD and $A'D'$ remained as shown. However, a modification that is necessary for machining an impeller changes the root contour of the vane.

In describing the basic vane theory, only the development of a series of straight lines has been considered. In views *a* and *b*, Fig. 2, the lines 1, 2, . . . 11 would represent the center lines of a cutter in a machining set-up to give the basic straight-line generation indicated. But a milling cutter of the type described here cuts at the outside of whatever diameter it happens to be. As this particular type of cutter will have a maximum diameter of approximately 2 inches, this will result in the root contour of the vane at the hub being a much flatter curve, as shown by dotted line $A'D''$, view *c*, than the theoretical line $A'D'$.

Since it is not generally feasible to make the impeller so wide that dotted line $A'D''$ can continue out to the required outside impeller diameter, it will intersect the back face at some point W, leaving deep scallops in this face as shown in view *b*, Fig. 4. As the air flows past the scalloped portion of the vane passage, the air in the rotating impeller will be dragged across an adjacent stationary face—usually an extension of a diffuser wall. This causes additional fluid friction, as well as recirculation losses, and also introduces a vane vibration problem.

A further disadvantage resulting from this modification is that air flowing close to the vane root suffers a sharp change of direction of flow, as shown by the angle between lines $A'W$ and WD' in view *c*, Fig. 2.

To eliminate the losses resulting from the open scallops in the back face, a separate disk, Fig. 5,

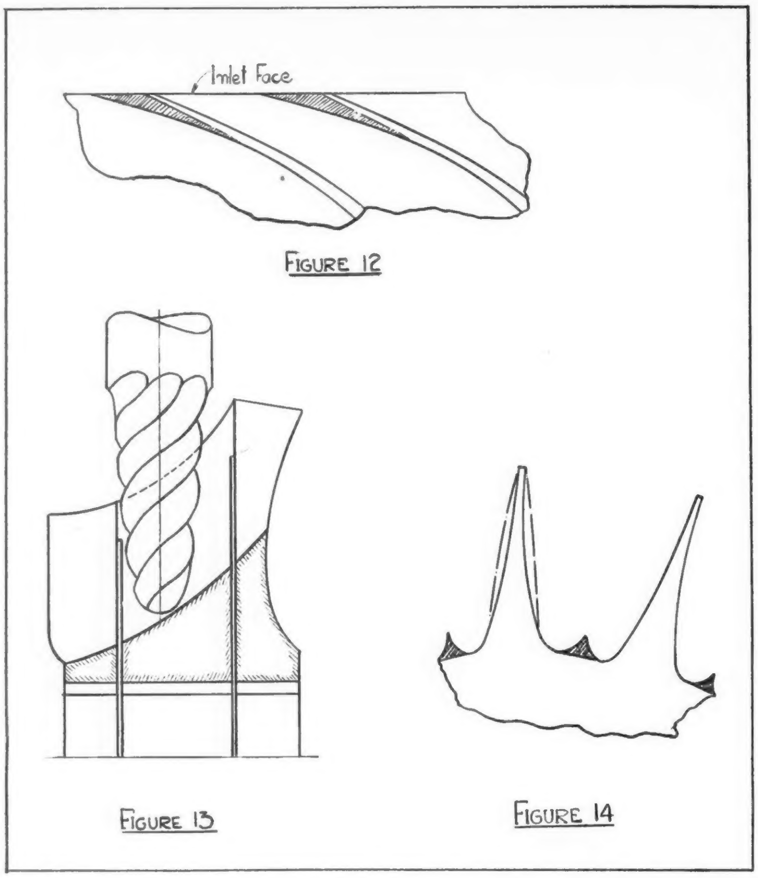


Fig. 12. The shaded areas show excess material which must be removed at the vane inlet edges to give the correct inlet area and angle

Fig. 13. Set-up for machining impeller vanes in which the cutter is set radially

Fig. 14. The shaded areas show excess material left by the machining set-up illustrated in Fig. 13

was added to the impeller to close up the scalloped portions. It was also felt that the straightening effect on the disk of the centrifugal force would cause a pressure to be exerted on the adjacent edges of the vanes, thus having a damping effect on induced vibrations. However, the thin disk was difficult to machine to the exact shape required, contact pressure on each vane could not be guaranteed, and the combined centrifugal and bending stresses to which the vane was subjected resulted in early material failure.

To improve the vane trough condition at *W*, view *c*, Fig. 2, which would cause turbulence, a modification in the machining set-up is possible that will not affect the major design requirements of the impeller.

It will be seen that the distance *X*, view *b*, Fig. 2, and Fig. 3, is the amount the impeller inlet face is set below the axis of oscillation of the cradle and the plane of rotation of the cutter. The larger the value of *X* (and consequently, angle α, view *a*, Fig. 2), the steeper will be the slope of the vane root trough as indicated in Fig. 6. But if *X*, and as a result angle α, is made too large, it may be detrimental to the inlet flow near the vane roots by causing a sudden change in the direction of the flow, as indicated by arrow *Y*. These sudden changes in flow direction are opposed to the realization of high efficiencies.

A secondary effect of using a large angle α is to cause a choking effect close to the discharge. This is not particularly apparent in looking at the impeller section, Fig. 6, but if a cross-section is made at *a–a*, (see Fig. 7), it will be seen that the cause of the restriction is the large fillets (approaching 1 inch in radius) left by the larger end of the cutter.

This restriction will also be apparent if the area of an individual vane flow path is plotted against length along the mean flow path as in Fig. 8. The effect of the restriction is to cause an acceleration of air velocity, followed by a slowing down, which results in a loss of kinetic energy.

Any excess material could be removed in supplementary machining operations, but such operations necessitate a continuation of warped surfaces and a blending in of these surfaces, with the result that considerable expensive hand finishing and polishing are required to achieve the smoothness and continuity of direction of the surface so necessary for high efficiency. For these reasons, any initial vane generating set-up which requires the removal of a considerable amount of material in supplementary operations must be considered a failure, or at least a step in that direction.

As test experience accumulated, it was apparent that fatigue failure due to vibration of the vane tip close to the inlet face would occur after

a relatively short life. The material used for the impellers was 14S–T aluminum alloy with an ultimate strength of 69,000 pounds per square inch.

The inlet portion of the impeller was therefore made as a separate piece, incorporating a vibration damping design, as indicated in Fig. 9. The feature of this design is that, in turning the discharge section forging, an under-cut of 0.002 to 0.003 inch is put in the face which will be assembled next to the inlet piece. The outside diameter of the under-cut is made approximately 1 1/4 inches less than the finished face of the forging. When the two finished impeller sections are lightly assembled, only a 5/8-inch length of each vane will be in contact, and subsequent axial pressure will cause the vanes to be deflected slightly, so that they are loaded as a spring and the lower frequency vibrations will be effectively damped out.

When further tests showed that occasional vibration fatigue failures of the vanes in the discharge area could be expected, the same solution was applied. The discharge portion of the impeller was also made a separate piece, and the center section under-cut, as described, on both faces. All subsequent impeller designs were variations of the three-piece construction shown in Fig. 10.

With a three-piece impeller construction, each piece may have its vanes generated in a different machining set-up, so that the assembled impeller has the desirable feature of a maximum value of angle θ, view *d*, Fig. 2.

This results, however, in the material of the shaded areas *a*, *b*, and *c*, Fig. 11, being left for supplementary machining and vane-matching operations. Other places on the vanes requiring cleaning up operations after the basic vane generation are shown by Fig. 12, where surplus material on the vane inlet edge (shown shaded) has to be removed. Fig. 7 shows large fillets of approximately 1 inch radius which have to be removed back to the dotted lines, so that, in operation, the air leaves the impeller in a solid stream without the interruptions which would be caused by heavy vane discharge edges.

Other Methods of Machining Impellers

One naturally questions the possibility of generating the vanes with the cutter set radially, as shown in Fig. 13. This approach was tried in connection with an early design, and many broken cutters were the chief product. The major difficulty was that the vanes were so close together in the inlet portion of the impeller that a cutter not over 1/2 inch maximum diameter, tapering over its 4-inch length down to 3/16-inch diameter, was required.

With the use of larger diameter impellers that were split into three sections and could be machined separately, this approach has been successful. One side of a vane is machined at a time, and the shaded area, Fig. 14, represents the excess material to be removed after the vane cutting is completed. As this is simply a matter of removing metal down to a diameter, without involving any blending difficulties, no problem is presented.

This method has the further advantage that the cross-section of the vanes more closely approaches the desirable hyperbolic profile that gives minimum stress in the vanes, whereas the standard method of machining shown in Fig. 4 always generates a vane section that is slightly

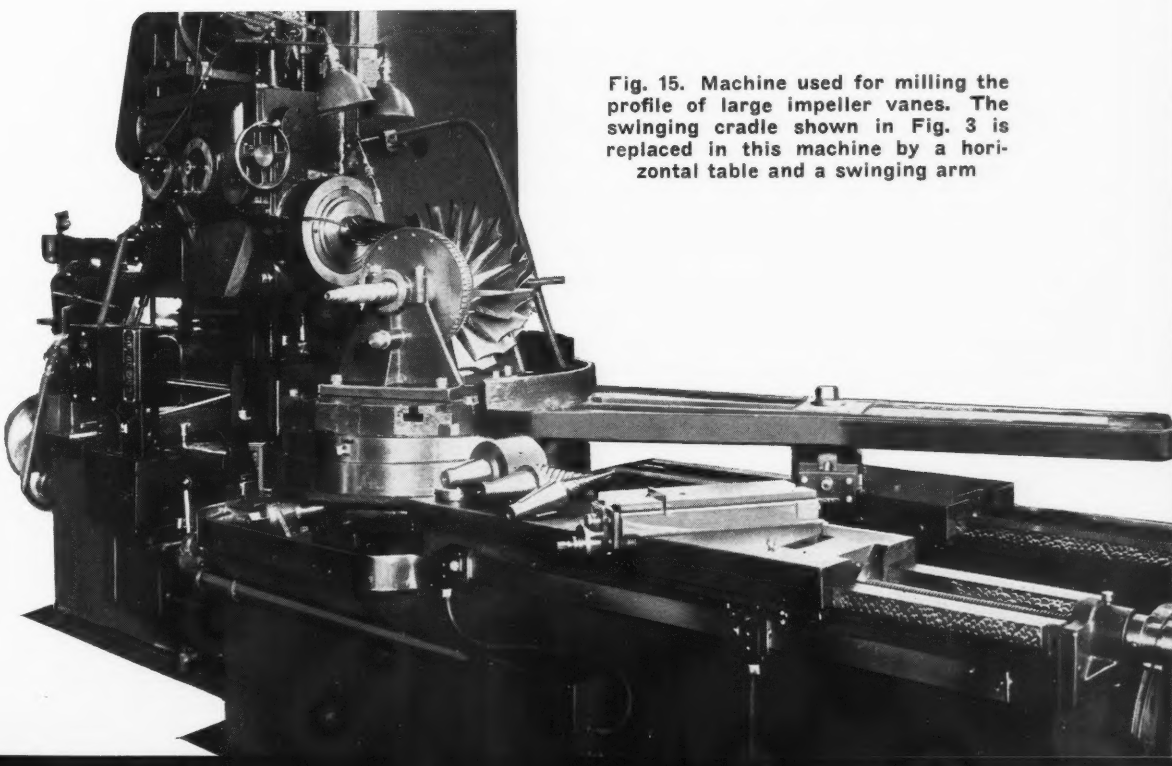


Fig. 15. Machine used for milling the profile of large impeller vanes. The swinging cradle shown in Fig. 3 is replaced in this machine by a horizontal table and a swinging arm

convex as indicated by the dot-and-dash lines in Fig. 14.

The heading illustration shows impellers of the three-piece type construction previously described. Fig. 15 shows a Wiedemann machine which is larger than those referred to as having a cradle swinging between trunnions. The smaller machines were made for aluminum impellers, whereas the machine illustrated was used for generating vanes of high-temperature alloy-steel turbine wheels up to 40 inches in diameter.

It may be noted from Fig. 15 that all of the movements take place at right angles to corresponding movements on the small cradle type machine, the set-up for which is illustrated in Fig. 3. The reason for this was that to accommodate 40-inch diameter wheels in a swinging cradle type would have involved holding a massive weight at an angle, and would have taken a large floor space. In the large machine, the swinging cradle is replaced by a horizontal table with an arm attachment, the rate of swing of the arm and the table being controlled by the gears shown at the right.

Once set, the machine is automatic in operation, except for indexing, the depth of cut being controlled by two micro-switches shown in the foreground. The indexing plate for the number of vanes is seen in front of the turbine wheel.

* * *

Western Metal Congress and Exposition in March Pointed Toward Critical Problems

The seventh Western Metal Congress and Exposition, which is to be held in Oakland, Calif., March 19 through 23, has for its theme "Production for America," and is directed toward problems important to the entire metal industry in the face of the critical world situation.

Two phases of production will be considered —production for defense or rearmament, and production for civilian or non-emergency use. The need for conservation of strategic materials and substitution of others required less urgently will be stressed not only by all speakers at the Congress, but by all distributors in the exposition halls. The Congress and Exposition, last held in Oakland in 1947, is sponsored by the American Society for Metals, with the cooperation of western sections of the American Society of Tool Engineers, the American Welding Society, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining and Metallurgical Engineers, the Society of Automotive Engineers, the American Foundrymen's Society, and allied associations.

Hydraulic Speed

PROBLEMS of cost reduction in the operation of machine tools may often be solved by speeding up production through the use of hydraulic duplicating attachments. Greatly reduced costs have been achieved with tracer-controlled equipment. Duplicating equipment that utilizes a hydraulically controlled cutting tool and a compound attachment for generating work shapes from a model or templet is manufactured by the Turchan Follower Machine Co. of Detroit.

The Turchan duplicating attachment shown applied to a lathe in Fig. 1 is built to suit any combination of feeds, speeds, and tooling that can be used on a lathe. The hydraulic cylinder provides adequate power to take the heaviest cuts with any type of tooling. The job illustrated is the contour duplicating of an 11 1/2-inch diameter shaped roll of chilled iron. The time required to complete the work was only six hours, compared to thirty-four hours with the method formerly used.

In another case, a 4 1/4-inch step shaft was turned on a 16-inch lathe similarly equipped. The depth of cut was 1/2 inch; the speed 255 feet per minute; and the feed 0.018 inch. Formerly this job required forty-eight minutes, while with the new method, only fourteen minutes was needed for each shaft.

The important functional feature of this duplicating attachment is that the tool-slide operates at a 45-degree angle to the work axis. This motion, combined with the longitudinal movement of the lathe carriage, permits the reproduction of perfectly square shoulders, as well as radii and bevels, in exact accordance with any square shoulders, radii, and bevels encountered by the tracer as it traverses the templet.

Among the advantages of this method of duplicating is the high quality of surface finish that can be attained by taking an uninterrupted cut with a single-point tool and the elimination of special form tools for turning intricate shapes.

Fig. 2 shows a Diesel locomotive axle being turned on a 25-inch hydraulic duplicating lathe. This job was done in 1 1/2 hours by Turchan controls, compared with eight hours required with ordinary methods. The tooling for this type of duplicating is simple, involving only the

Duplicating Attachments
Contour Turning and Facing

Fig. 1. Lathe set up with a hydraulic duplicating attachment for completely machining a chilled iron roll, 11 1/2 inches in diameter, in six hours

normal procedure of positioning and clamping two tools in a standard four-way tool-block. The roughing and finishing tools are set so that, when the finishing tool is indexed into position, it will remove 1/32 inch on the sides and 1/64 inch on the faces of the work. With a simple gage, the tools are quickly set (or replaced) in the block.

Trial cuts are made with the finishing tool on the first work diameter until a micrometer shows the finished size. The machine is then automatically set to reproduce all diameters from the round model or flat templet, so that subsequent measuring is eliminated.

The fine surface finish produced as a result of the smooth, continuous advance of the carriage by power feed, coupled with the floating, tracer-controlled action of the angular tool-slide, has, in some cases, eliminated final grinding.

Another important characteristic of this duplicator is its ability to reproduce the templet shapes accurately on the work to within 0.002 inch. Tapers, regardless of length, shoulders, and depth, are generated accurately, while lengths and diameters are also reproduced within this limit.

Contributing to this precision duplication is the short flexible connection between the tracer metering valve and the tool-slide actuating piston. This insures a more positive and sensitive displacement of fluid than is possible with longer connections. Since it only requires 300 pounds per square inch pressure, the Turchan hydraulic

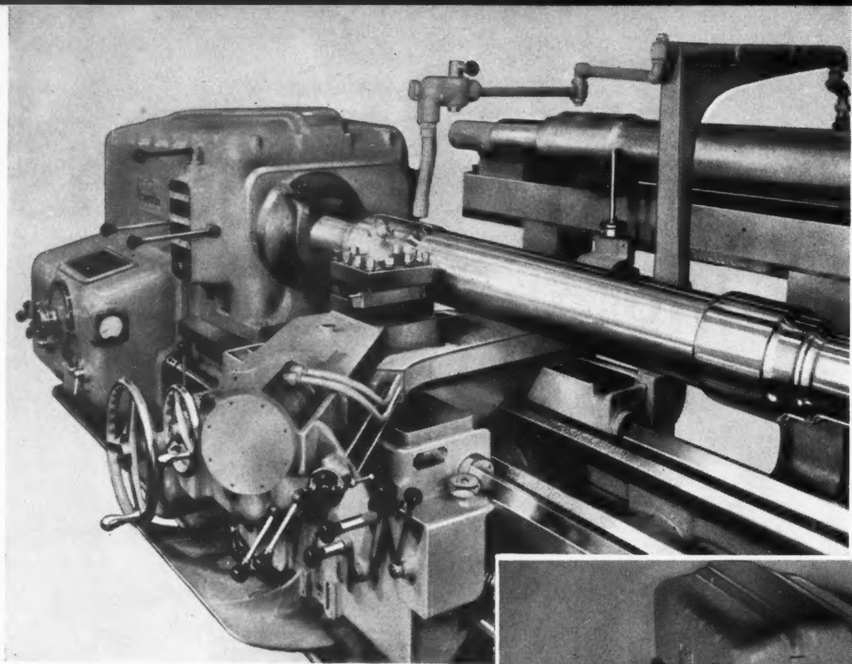


Fig. 2. A Diesel locomotive axle is turned by means of hydraulic duplicator control, using a full-size work-piece as a templet

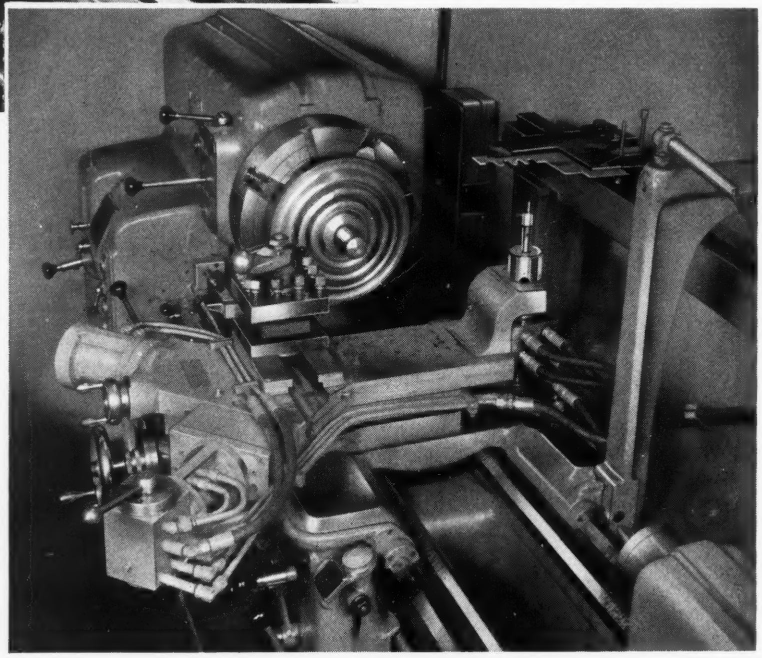


Fig. 3. Turning the face of an intricate die-block by the use of a dual follower attachment employing a flat templet

equipment is not subject to leakage and other troubles frequently experienced with high-pressure hydraulics. Basically, the equipment consists of a hydraulic pump and a hydraulic tracer valve, which controls the movement of the 45-degree tool-slide.

The dual turning attachment shown in Fig. 3 permits the use of both cylindrical and flat templets, which means that standard work-pieces can be used as templets, avoiding the need for specially made templets. Cylindrical templets are, of course, much easier and less costly to make than flat ones, since this work is a simple turning job. The contours of the 12-inch diameter mold shown in Fig. 3 were produced in five hours, compared to thirty-two hours without this equipment.

Provision is made for securely supporting and accurately positioning the templets. Brackets attached to the lathe bed support a heavy adjustable bar having a wide dovetail on which are adjustably mounted the centers for supporting cylindrical templets and the clamping blocks for holding flat templets. Endwise micrometer adjustment of the bar facilitates accurate positioning of the templet in relation to the work.

A cross-slide equipped with two compound rests mounted at 45 degrees to the lathe center line and at 90 degrees to each other replaces the conventional cross-slide. The 45-degree compound movements are controlled by the tracer, while the cross and longitudinal travels are actuated by the conventional lead-screws. This new combination of movements doubles the function of tools on any standard lathe.

Parts with contours on the diameter or face can be duplicated, as well as a combination of both. The lathe is operated in the conventional manner, none of its standard controls being removed. To change from one angular slide to the other, a single change-over lever is provided, which also indicates the direction of duplicating. Only one slide is used at a time; the other remaining locked in position. Thus square, right-, and left-hand shoulders, including under-cuts and radii, can be machined.

Postforming
Thermosetting Laminated Plastics

The First of a Series of Articles on an Improved Method of Forming Laminated Plastic Sheets. The Effects of the Process on Undercured, Normal, and Overcured Forming Stock are Described, as well as the Deforming Effects of Fabric Filler Materials

By WILLIAM I. BEACH, Executive Assistant
North American Aviation, Inc.
Los Angeles, Calif.

POSTFORMING of fully cured, infusible, insoluble, thermosetting laminated plastics ("C" stage) is akin to metal forming. By "postforming" is meant the forming or bending of laminated plastic sheets as opposed to forming plastic parts from the raw material by molding processes. Like metal, laminated sheets are stretched or deformed by externally applied forces. Metal-forming dies and tools may be used for this work, although dies and molds devised especially for the postforming process are simple and inexpensive to make.

According to the polymerization theory, a chemical reaction occurs during the curing process, resulting in the formation of a new compound comprised of large, complex molecules. Characteristic of thermosetting resins, the molecules group themselves into lattice-like, three dimensional structures held rigidly together by cross-linking bonds. Hence, when strong intermolecular forces of attraction prevail, the resin possesses thermosetting properties—that is, resistance to deformation by heat and swelling by solvents.

An interpretation of this theory in so far as it pertains to the "irreversibility" aspect of heat-hardening resinous materials leads to some confusion and misgivings. The present practice of softening and subsequently shaping commercial laminated sheet material is contrary to the generalization that thermosetting products when properly cured are not subject to reshaping influences. Much information and pertinent facts uncovered by formability investigation of available thermosetting laminates impregnated with conventional as well as modified types of resin have succeeded in throwing some light upon the subject. Dealing primarily with the handling and forming characteristics of laminated stock, this investigation showed that:

1. It is desirable to avoid the use of undercured material.
2. All thermosetting laminates investigated deformed at their critical softening temperature, irrespective of the degree of cure.
3. Optimum formability and maximum retention of physical properties depend largely upon the judicious selection of filler material.

Undercured Forming Sheet

In far too many instances, the desirable softness of the resinous binder has been overemphasized to the extent that undercured laminates are frequently used for forming and drawing. Normally, undercured products are no better than fully cured or, in some cases, overcured sheets for such uses. Even attempts to use undercured sheets, in the belief that full and complete cure would be achieved in the forming operation, have proved unsatisfactory from the standpoint of stability and rigidity. Improperly cured laminates when formed tend to produce inferior parts because of their delaminating characteristics, insufficient stiffness to retain the formed shape, poor resistance to dimensional changes, and questionable physical properties.

Fully Cured and Overcured Forming Stock

Thermosetting laminates are susceptible to heat deforming forces throughout their entire useful range. Various tests conducted with over-

Note: The Postforming Process is covered by United States and foreign patents, and pending applications are assigned to North American Aviation, Inc.

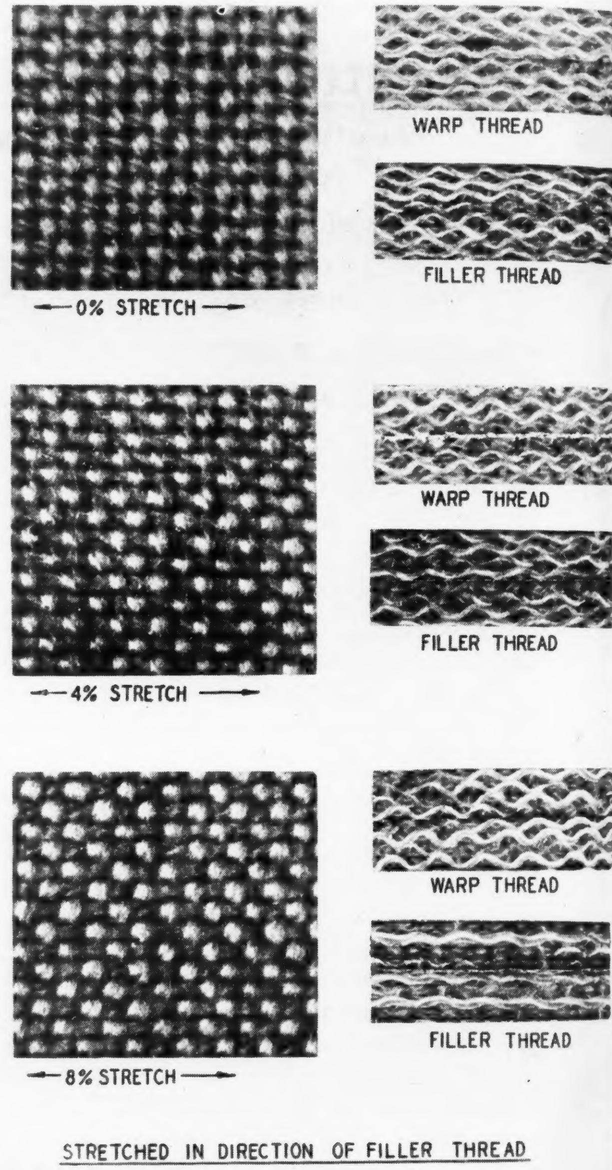


Fig. 1. Comparison of the change in thread pattern when a laminate is stretched in the direction of the filler thread

cured specimens subjected to temperatures and pressures exceeding normal curing conditions by several hundred per cent showed that satisfactory formability was retained. Evidence of softening properties was discovered in these materials, which consisted of different types of resinous binders, up to the final product, at which point structural breakdown and decomposition of resin took place.

Likewise, the behavior of all specimens gave rise to the speculation that very little difference actually exists in the molecular structure of normally cured samples and extremely overcured ones. Outside of an increasing tendency toward brittleness—no doubt caused by dehydration of the resin and fabric filler and other causes—overcured laminates are capable of good performance, although somewhat restricted to larger bend radii and generous curved shapes.

With certain polymerization-condensation resins such as phenol (plasticized or unplasticized), a flat laminated section may be exposed to a heating medium at or above its curing temperature, softened and then bent to a minimum bend radius equal to its thickness for sheets below 1/8 inch. The same specimen, if straightened, can again be subjected to heat at the same condition as previously stated and reformed.

This can be repeated several times without creating surface crazing of the resin or rupture of the fabric. Thereafter, the results are erratic and unpredictable. A state of deterioration appears to set in and the material no longer responds to conventional treatment.

Fast curing resins of the pure phenol or cresol type are usually limited to four or five reforming operations, whereas, cresylic acid mixtures are likely to stand reforming many times more. In some cases, where the proportion of phenol is obviously low, cresylic laminates are definitely heat reactive, and although capable of resisting solvents, this material behaves somewhat like the long chain type of plastics.

Highly plasticized resins ordinarily are not preferred to the unmodified laminating varnishes, because of the after-forming effect. Such material usually swells appreciably when heated, and frequently produces a rough "resin starved" surface. Aniline formaldehyde or a combination aniline and phenol formaldehyde resin possesses good formability characteristics, and would have greater possibilities for serviceable uses, provided dimensional stability could be maintained under severe climatic changes.

The formability characteristics of precured low-pressure and contact type resin-impregnated fabrics are comparable in many respects to high-pressure laminates. Experimentation with low-pressure laminates has been limited to several types only. Those investigated, including the allyl alcohol group, hold considerable promise.

Deforming Characteristics of Fabrics

If deflected beyond their modulus of rupture in bending, thermosetting laminates will fail suddenly and completely. But before this occurs, the resin will have crazed quite noticeably due to poor elongation, and cracks will have opened up in the resin pockets between the filler and

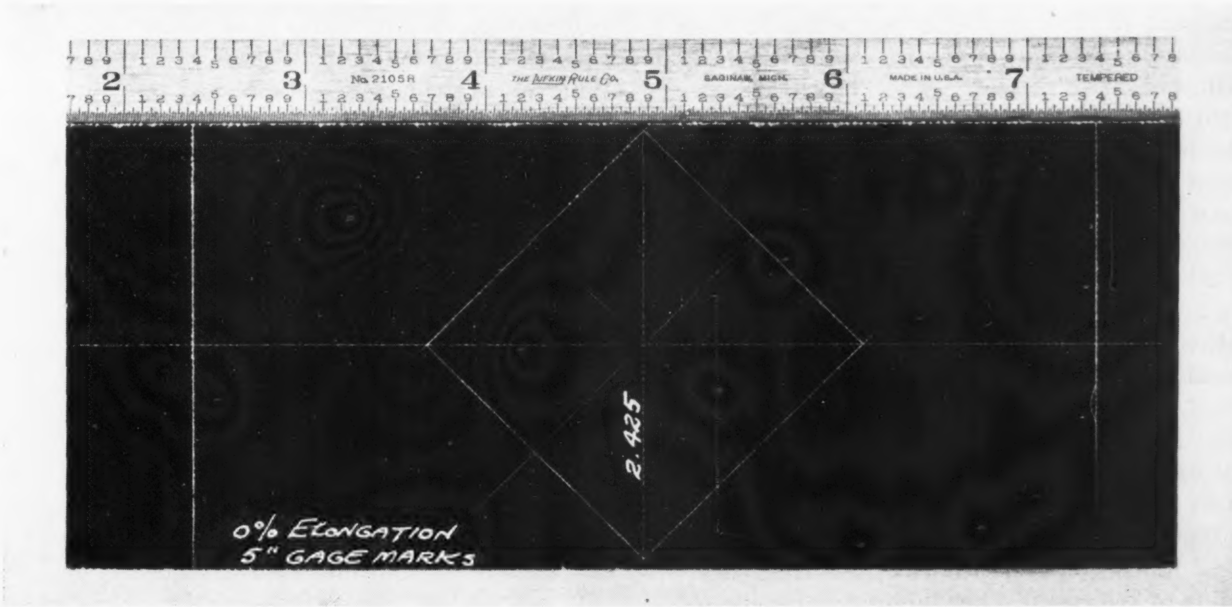
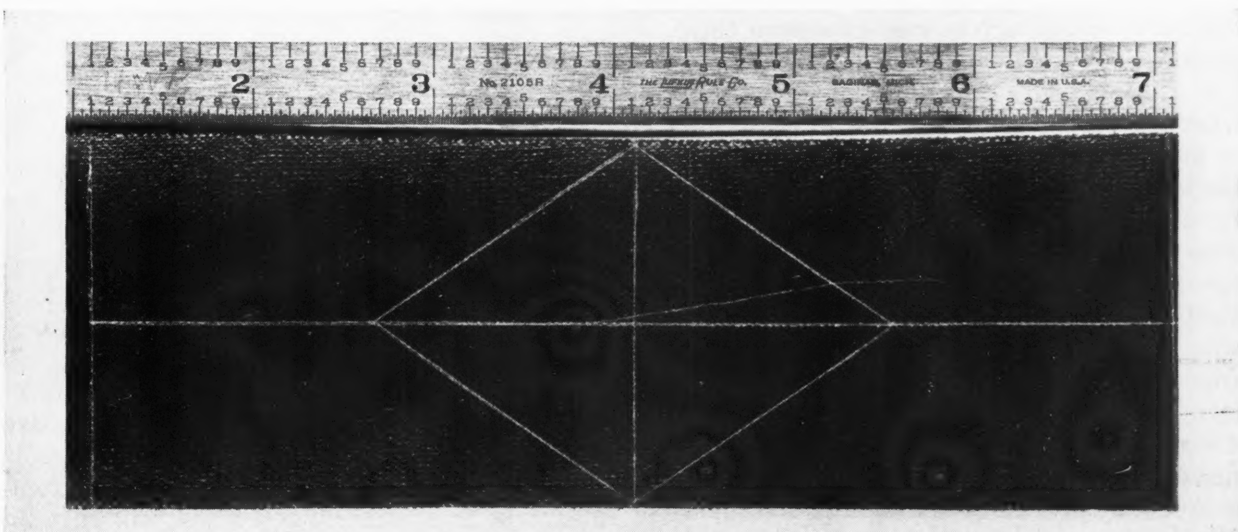


Fig. 2. (Above) Laminated material scribed with 5-inch gage marks for stretching on the bias. Fig. 3. (Below) The laminated specimen illustrated in Fig. 2 after being subjected to 20 per cent elongation on the bias



warp threads. However, when processed for forming, laminates have a different set of characteristics. The resin is no longer brittle, but soft and pliable. Accordingly, the fabric may be stretched and shaped as desired within, of course, the limiting elongation of the yarn. When, subsequently, the resin has reverted to its original condition, a forming operation has been accomplished without crazing of the resin or rupture of the fabric.

The resin binder is an amorphous compound possessing stable mechanical properties. However, by the addition of a filler, a wide variety of properties may be made available. They are primarily dependent upon the type of reinforcing material selected for the laminating. Of the numerous types of fabric employed for this purpose, the ones most commonly used are army ducks, twills, and herring weaves and single or double filled ducks. Laminates assembled from any of these fillers ordinarily have excellent forming properties.

Inasmuch as technical information concerning the structure and weaving of cloth is not readily available, the investigation was based upon a study of the stretched and unstretched surface of formed laminates. In general, the fabric filler consists of lengthwise and crosswise threads woven in several different patterns. A typical 8-ounce duck of balanced weave construction shows each thread passing under one and over one. Presumably, the filler thread shuttles in

and out of the alternate warp thread and is pressed back tightly against the preceding or adjacent filler thread. Since both threads are held taut in the frame and impressed one upon the other, each has a crimped or wavy appearance. When impregnated, the resin fills the space between alternate threads and surrounds the junction of the filler and warp threads.

Although the fabric reinforcement is intended to add toughness and certain other characteristics to the resin, the mechanical properties would be considerably greater were the threads straight instead of crimped. To a certain degree, the forming of laminates accomplishes this straightening, ultimately improving many of their physical properties.

The stretching of the threads within a practical limitation is dependent upon the redestribution of the resin. When laminates are stretched, the threads parallel to the direction of the force straighten and move closer together. This movement is followed by a corresponding shortening of the threads lying normal to the direction of the force. As the threads move closer together, the resin occupying the space between them is squeezed out and redistributed.

Fig. 1 illustrates the change in thread pattern when the specimen is stretched in the direction of the filler thread. The difference between the stretched and unstretched samples is apparent from an inspection of both the surface and edgewise views. The threads are well defined and spaced with resin pockets, as seen in the unstretched specimen. Upon stretching, the lengthwise threads tend to straighten, while the crosswise threads shorten. This is visible in the pattern characteristics of the specimen elongated 4 and 8 per cent, respectively. Packed tightly together, the interwoven threads, devoid of resin pockets, take on an appearance of homogeneity.

A marked change in the shape of the threads is seen in the edgewise views. The nodes of the threads lying parallel with the direction of stretch become flatter as the specimen is lengthened. On the other hand, the nodes of the opposite threads become sharper with each increment of stretch. This accounts for the prominence of the crosswise and the recession of the lengthwise threads in the surface views. Accordingly, the resin that formerly occupied the spaces between adjacent threads becomes redistributed over a greater portion of the extended lengthwise thread.

Material stretched on the bias elongates more than twice as much as when pulled in either the crosswise or lengthwise direction. In this case, the deformation of the weave contributes to the elongation. Specimens extended in the bias direction behave differently from those stretched parallel to the lengthwise or crosswise threads. Whereas, in the latter case, elongation is achieved by lengthening the threads, in the former instance, the same results are obtained by a progressive deformation of the weave.

The alignment of the threads at an angle of 45 degrees to the direction of the deforming force adds considerably more elasticity to the cloth. Upon applying tension loads, the square-weave pattern formed by the diagonal threads collapses into diamond configurations. Following the tensile load, lateral compression forces exert component pressures normal to the diagonal thread and, hence move them closer together. This is illustrated effectively by the bias specimen shown in Figs. 2 and 3 subjected to 0 and 20 per cent elongation, respectively.

* * *

Conference on Industrial Personnel to be Held at Columbia University

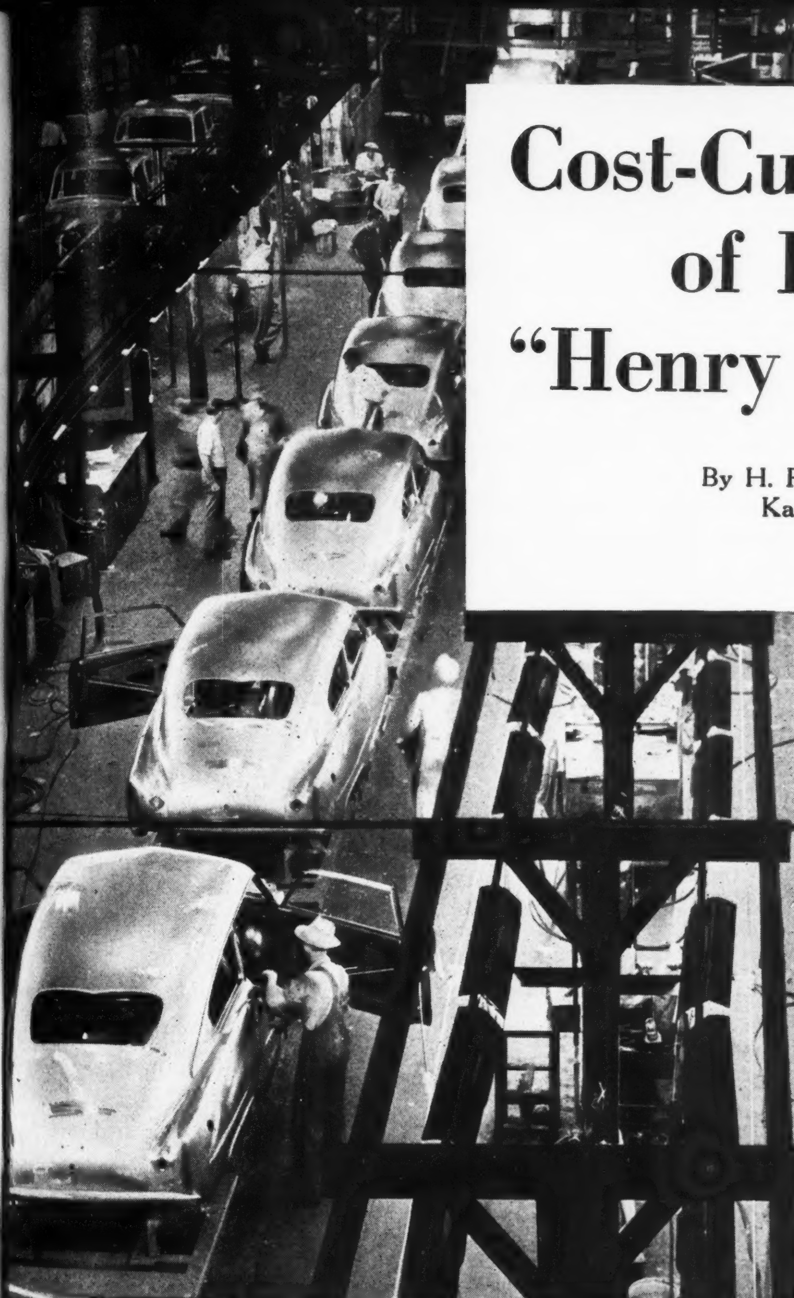
A conference on industrial personnel is to be held at Columbia University, March 19 to 23, 1951, to discuss the general theme, "Frontiers of Personnel Administration." This is the first of the 1951 series of conferences on various phases of industrial organization and management to be sponsored, as in past years, by the Department of Industrial Engineering.

Lectures and round-table discussions on various phases of personnel administration will be features of the conference, in which approximately fifty industrial and business concerns are expected to participate. Each company represented will send both a top personnel executive and a first-line supervisor to the conference. It is believed that this is the first time that foremen, who must carry out policies, will have an opportunity, in such a conference, to express their reactions to personnel administration ideas in the formative stage.

Professor William W. Waite, head of the Personnel Area of the Columbia Department of Industrial Engineering, will be director of the conference, and will be assisted by David N. Edwards, instructor in industrial engineering at Columbia. Further information can be obtained from Mr. Edwards, Department of Industrial Engineering, Columbia University, New York 27.

* * *

In 1949, a total of 6,253,602 cars, trucks, and buses, valued at over $8,000,000,000, rolled off American assembly lines—more than three times the output of all other countries combined.



Cost-Cutting Methods of Producing "Henry J" Car Bodies

By H. R. SMITH, Master Mechanic
Kaiser-Frazer Corporation
Willow Run, Mich.

A New Method of Body Die Making Involving the Use of Cast Plastic, a Sharp Reduction in the Number of Stampings Required per Car, and the Increased Use of Automatic Welding Machines Has Made Possible the Production of a Low-Priced Automobile

IN spite of the recent increases in wage and material costs, engineers of the Kaiser-Frazer Corporation have succeeded in designing and producing a low-cost light automobile. The recently introduced "Henry J" is a full-size light car weighing only 2300 pounds—800 pounds less than other cars in the same class.

To produce such an automobile under the present economic conditions required the utmost co-operation and ingenuity of the designers, tool engineers, and production men. All unnecessary parts were eliminated, and only about one-third as many sheet-metal stampings are required as for the standard Kaiser car. For example, in eliminating the glove compartment, twelve stampings were no longer required. In many cases, this reduction in the number of stampings increased the size or complexity of those necessary. The roof stamping, for example, extends from the windshield clear back to the rear edge of the floor pan. However, many small press operations have been eliminated.

Separate garnish moldings, used to trim the instrument panel and interior of the doors on conventional cars, have been included in the design of the body stampings, and are simply painted the same color as the car. Vents in the windows have been eliminated, and the rear fenders are bolted to the body for easy replacement.

Plastic Molds Cut Tooling Time

The transition of this new low-price car from the designing board to actual production was made in record time—and at a considerable saving in cost—through a new method of making the body dies. By using plastic molds of clay body models in making the steel stamping dies, the need for more costly wooden models was eliminated, accuracy was improved, and the time

required for producing the body tooling was reduced by approximately one-half.

Previously, the contour lines of hand-molded clay models were transferred to paper by means of templets. After refining or truing the lines on the drawing, detail drawings and new templets were made. These templets were used in making a full-size, wooden master mock-up of the car. Then new templets were made again from the refined contour lines of the master, and these were used to lay out the master draft on metal. From the master metal draft, mahogany die models were made. Finally, plaster castings of these mahogany die models were used in contour-milling the body stamping dies on a Keller machine.

With the new method, developed by Kaiser-Frazer engineers in cooperation with the Kish Plastics Co., Lansing, Mich., plaster molds made from the clay models are used for casting plastic models. A urea-formaldehyde plastic is poured into the plaster mold over a light-weight honeycomb core, and cured in an oven. Some warpage occurs during curing, but the cured model is dimensionally stable. After the curing operation, the model is returned to the mold, and a thin coat of plastic is poured on the surfaces of the rough casting. Contours of the mold are accurately retained, and the plastic does not warp because of the cured backing.

Surface lines of the plastic molds can be quickly refined because the plastic is easy to work. After one side of the mold has been trued, templets are made, reversed, and used in truing the opposite side. Plastic is also employed to simplify templet manufacture. The templets are cut to the approximate contour of the model, and plastic edges are applied to the templet, Fig. 1, to fill the clearance between the edges of the templet and the surfaces of the model.

The templets are used to lay out the master body draft on metal, from which detail drawings are made. The refined plastic master models are employed for casting plaster molds, from which plaster models are made for use in machining the body stamping dies. Also, plastic models, made from the plastic master and provided with brass wearing surfaces on the edges, are used as production checking fixtures. Fig. 2 shows refined plastic body sections fitted together to form a "Henry J" mock-up.

Large Dies Required for Roof Stamping

The roof stamping, which, as previously mentioned, extends all the way from the windshield to the rear edge of the floor pan, is the largest single sheet-metal part required for the new car. Deep-drawing, cold-rolled steel sheets, 70 inches wide by 134 inches long by 20 gage (0.0359 inch thick) and weighing about 98 pounds each, are employed for the roof. Only four large dies are required to completely draw, trim, flange, and pierce the roof panel.

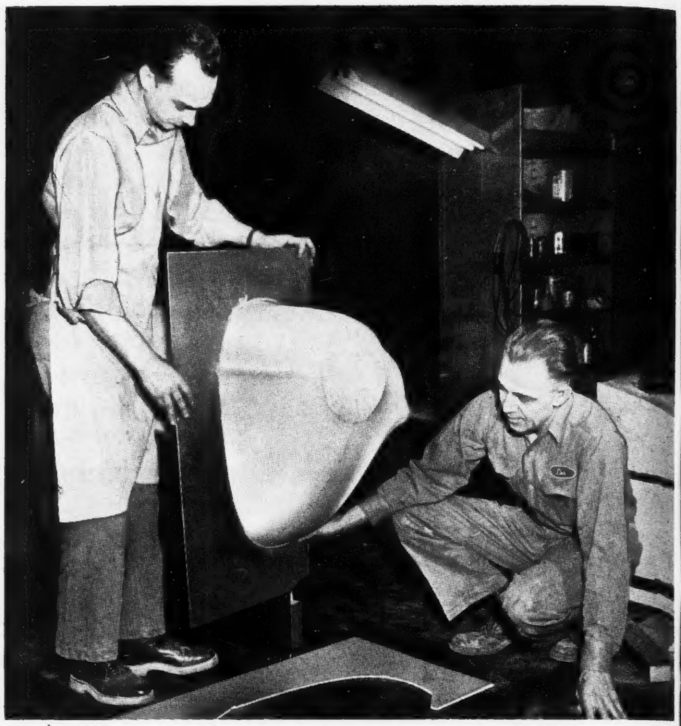
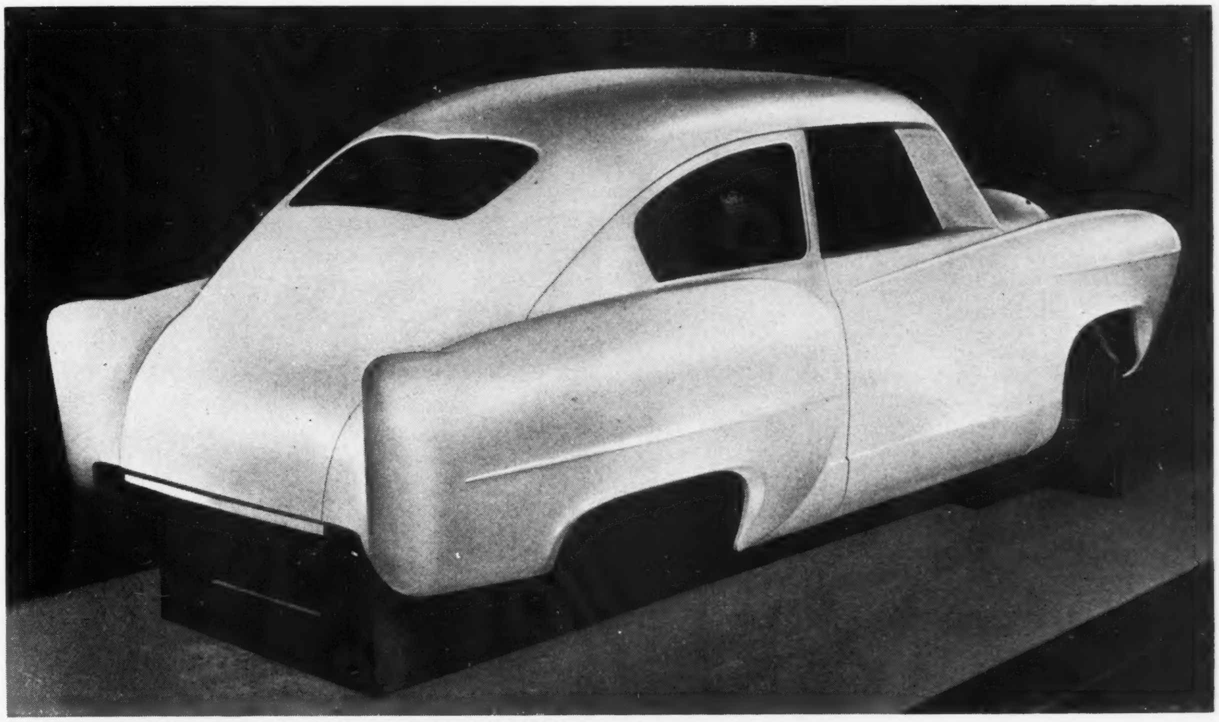


Fig. 1. Plastic edges are applied to rough-cut templets to make them conform with the contour of the plastic front-fender model

Drawing of the roof is performed on the Clearing triple-action 1500-ton press seen in Fig. 3. A force of 600 tons is applied to the blank-holder, while 900 tons force is exerted on the inner slide. The third action of the press is not employed. Although the sheet is actually drawn to a depth of only 6 inches, the completed roof panel measures approximately 124 inches long by 59 inches wide by 24 inches deep. The drawing die is of sectional construction, so that the same die can be employed for drawing roof panels either with or without rear deck-lid depressions.

The drawn roof panels are trimmed and flanged on two Clearing, single-action, 900-ton presses. A huge, cam-actuated die, Fig. 4, weighing 60 tons, is employed for flanging. Flanging steels, mounted on horizontal acting cams on the lower die, are driven toward the work by vertical acting cams suspended from the upper die. An unusual feature of this die is that four holes—including the rear window opening—are pierced while the roof panel is being flanged. Piercing is completed and the roof panel is restruck on a Warco single-action, 200-ton press. A production rate of 100 roof panels per hour is obtained from each of these presses.



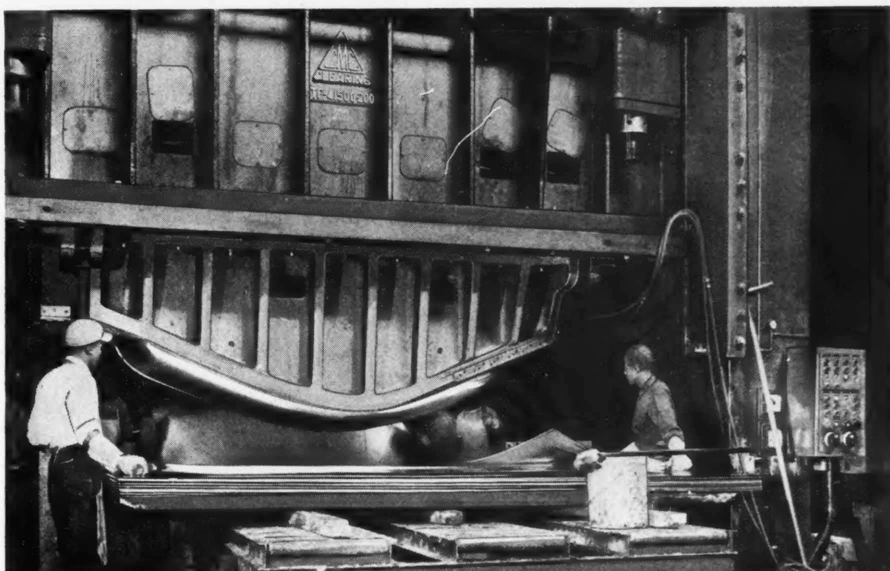


Fig. 2. After refining the surface lines of plastic automobile body molds, they are fitted together to form a mock-up such as illustrated

Fig. 3. Steel sheets, 70 inches wide by 134 inches long by 20 gage (0.0359 inch thick) are drawn into roof panels on a 1500-ton press

Fig. 4. A huge 60-ton, cam-actuated die is used to flange the roof panels. The die used for trimming can be seen in the rear at the left

Fig. 5. Two automatic, electronically controlled resistance welding machines are mounted side by side for producing complete floor-pan assemblies

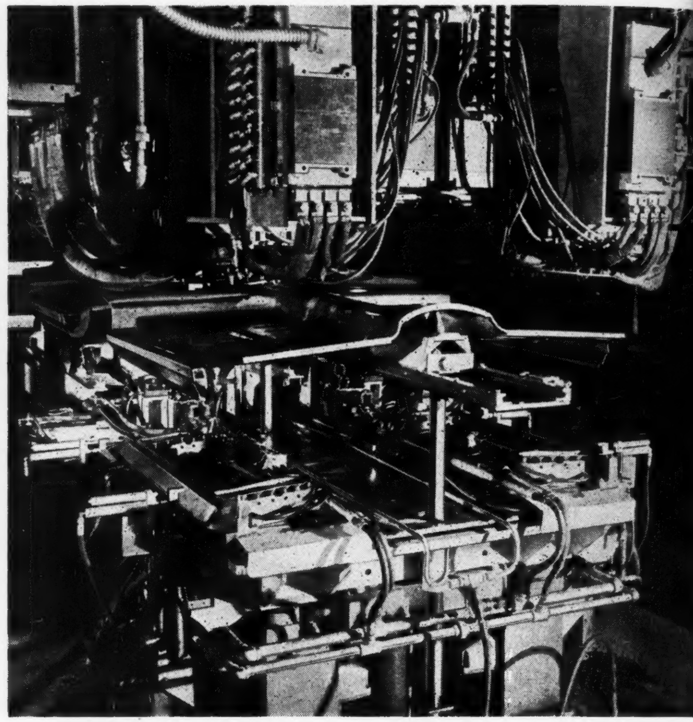


Fig. 6. Completely welded front floor-pan assembly is automatically transferred to a second machine, as shown in the illustration at the right, where it is welded to the rear floor pan

Automatic Welding Machines Speed Production

Complete floor-pan assemblies are produced on the two automatic, electronically controlled resistance welding machines seen in Fig. 5. While components of the front floor-pan assembly are being spot-welded together in the machine shown at the right, the rear floor-pan parts are welded in the machine at the left. The complete front floor-pan assembly is automatically transferred from the first machine to the second one, where it is spot-welded to the finished rear floor-pan assembly.

These automatic resistance welding machines, made by the Welding Machines Mfg. Co., are of standard four-post press design, permitting easy replacement of dies and modifications to take care of design changes. The first machine contains thirty-four transformers, and the second twenty-seven transformers. Each transformer, having a capacity of 30 KVA, supplies electrical current to four water-cooled electrodes. The use of small individual transformers permits employing short, equal-length cables, thus equalizing the electrical current supplied to each welding gun.

The lower die on the press contains the work-holding fixture and copper back-up plate, while the upper die holds the electrodes, transformers, and hydraulic cylinders for raising and lowering the electrodes. The complete welding cycle (including energizing of electrode solenoid, length of time electrodes are clamped to work and electrical current flows to electrode, release of electrodes, and "off" time) is automatically controlled by adjustable, electronic sequencing timers.

A front floor pan, placed on the transfer unit seen at the extreme right, is slid into position in the first resistance welding machine. Simultaneously, a welded front floor-pan assembly is automatically transferred to the second machine. Left- and right-hand body side-sill assemblies, seat track reinforcements, and front floor-pan stiffeners are located in the lower die of the welding fixture on the first machine, while two front and two rear seat cushion retaining brackets are located in the upper die.

These underbody parts, made from 14-gage mild steel, are nested in copper channels in the fixture, and are joined to the front floor pan, made from 18-gage mild steel, by 48 spot-welds in the first firing and 134 spot-welds in the second firing.

At the same time that the welding operations are being performed on the front floor pan, a

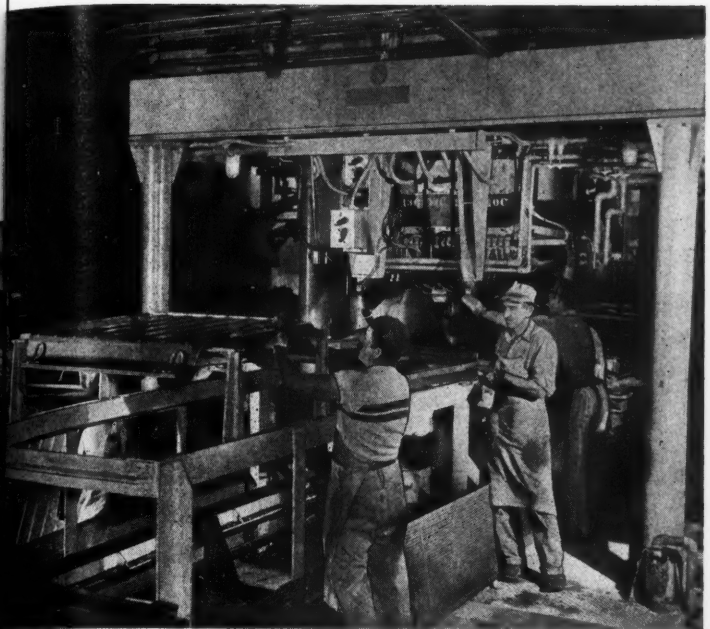


Fig. 7. When all underbody parts have been spot-welded to the pans, and the front and rear floor pans joined together, the assembly is unloaded

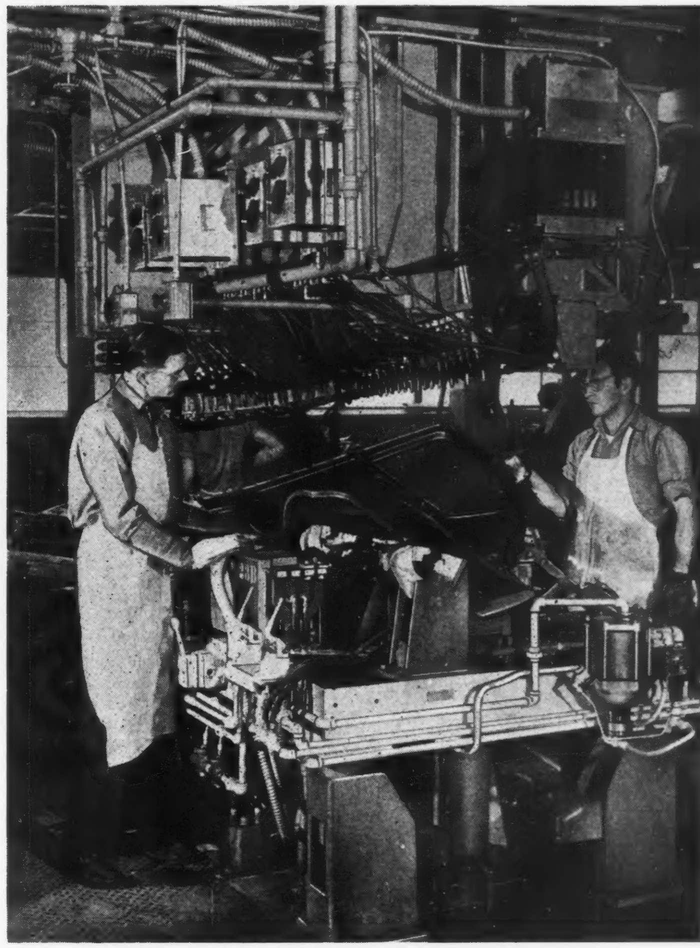


Fig. 8. A total of eighty-four spot-welds are made on this automatic machine in joining together inner and outer rear quarter-panel sub-assemblies

rear floor pan is located in the welding fixture on the second machine. A hinge assembly, which permits the rear seat to be pulled forward for access to the luggage and spare tire compartment, is located on embossments drawn in the rear floor pan and joined to it with twenty-seven spot-welds. Reinforcement assemblies (which are mounted across the under side of the rear floor pan), body hold-down reinforcements, and the spare-tire well stamping are located in the welding fixture on this machine.

The rear edge of the completed front floor-pan assembly, which is automatically transferred from the first machine, is placed in the welding position, overlapping the front edge of the rear floor pan, as seen in Fig. 6. The underbody parts and the front and rear floor pans are all joined together by 108 spot-welds.

The completed floor-pan assembly is automatically removed from the rear of the second welding machine, and is unloaded manually, Fig. 7. The two automatic resistance welders are capable of completing 100 floor pans per hour.

Similar automatic resistance welding machines, such as the one seen in Fig. 8, are employed for producing both right and left rear quarter-panel assemblies. The machine for welding left assemblies contains twenty-three 30-KVA transformers, which supply electrical current to eighty-four guns, while the machine for right assemblies has twenty-two 30-KVA transformers and eighty guns.

Sub-assemblies joined in these machines include inner and outer quarter-panels. The inner quarter-panel sub-assembly consists of two trim retaining brackets, which are joined to the stamped quarter-panel with sixteen spot-welds. The outer quarter-panel sub-assembly comprises a stamped quarter-panel, welded to the body lock-pillar assembly at fifteen spots. These two sub-assemblies, a rear-seat back-stop assembly, and a spare-tire support bracket are all joined together with eighty-four spot-welds in the automatic resistance welding machine shown. The rear quarter-panel assemblies include a non-movable window frame.

Complete Body Frame Built up on One Fixture

An unusual feature of the "Henry J" body production line is the use of framing "bucks" or fixtures, Figs. 9 and 10, for completely building up the body frame. Previously, only the

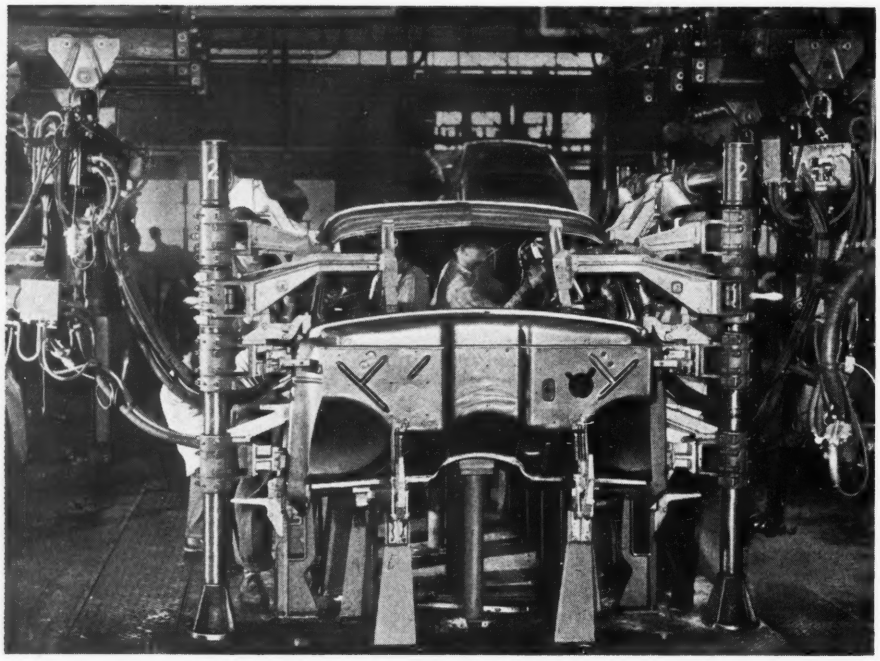


Fig. 9. Front view of the fixture employed to build up the frame of the complete automobile body. Swinging gates pivot about horizontal and vertical shafts

right and left rear quarter-panels and the roof panel were welded together in a "balloon" fixture. Now, the roof, both rear quarter-panels, the floor pan, the body cowl assembly, and outer and inner roof rails are all joined together on one framing fixture.

Five identical framing fixtures are employed. Six welding operators working at each fixture complete twelve body frames per hour. A total of 460 spot-welds are made on every framed body with ten portable, hand-operated spot-welding guns. Transformers are suspended from overhead monorails, and flexible cables carry electrical current to the welding guns.

Swinging gates or arms that pivot about horizontal and vertical shafts on the fixture hold the work locators and quick-acting clamps. First, the floor-pan assembly is positioned on locators in the framing fixture, and an air valve is actuated to raise locating pins into the body bolt-holes. The floor pan is clamped to the framing fixture at both right and left door openings. The body cowl assembly is then located and clamped in the fixture, after which the framing fixture gates are closed. Both left and right rear quarter-panel assemblies are positioned on the floor pan in the fixture, located by means of pins on the gates, and clamped in place.

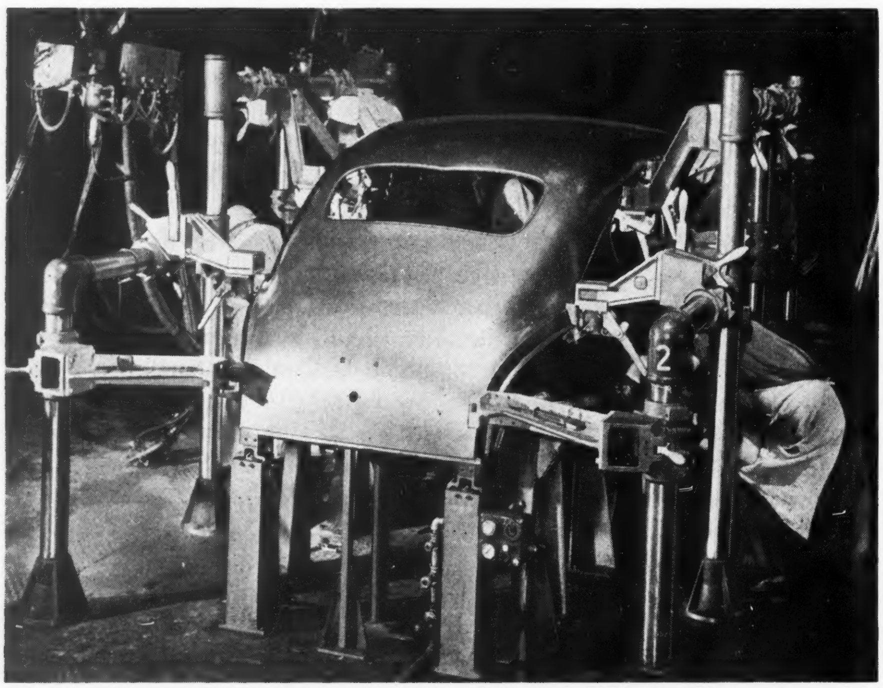


Fig. 10. Rear view of the framing buck, Fig. 9. Six welding operators complete twelve bodies per hour on each of five fixtures

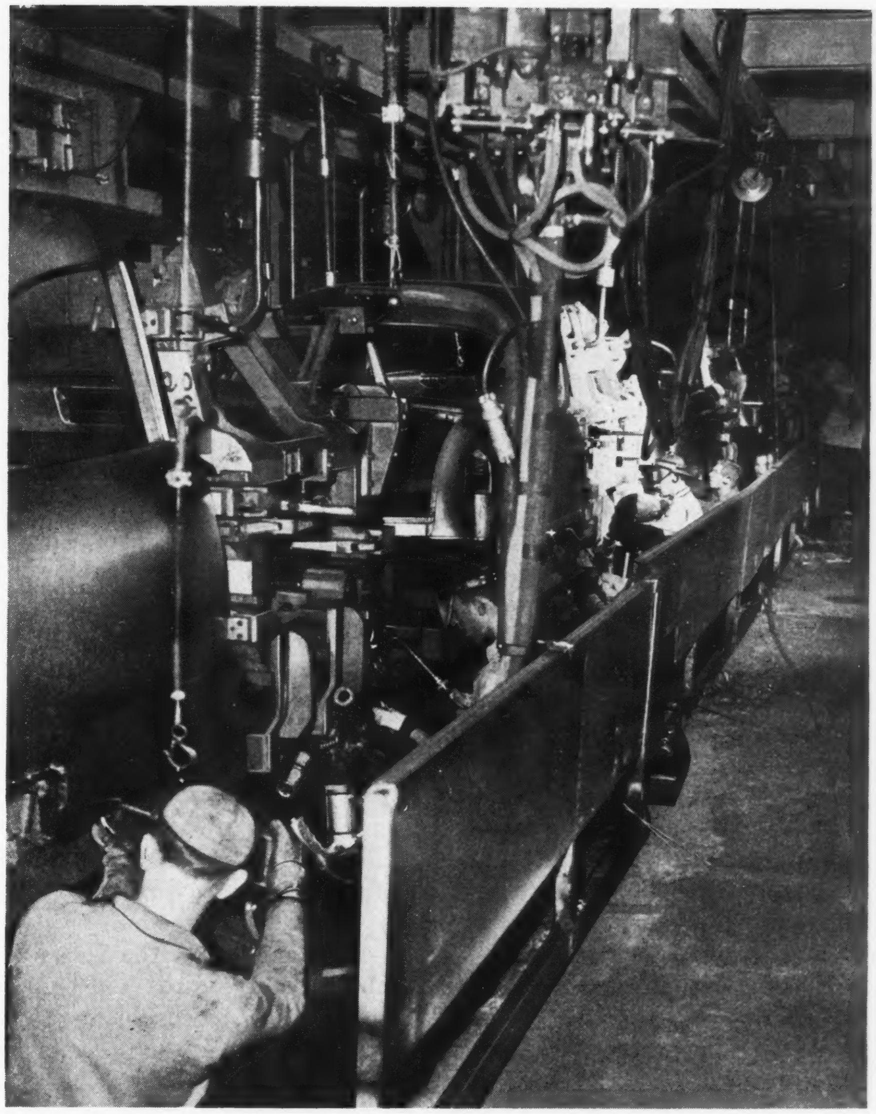


Fig. 11. "Body in white" line, where the framed body and other welded or stamped sub-assemblies for the new "Henry J" automobile are joined together

When the roof panel has been positioned and clamped, it is joined to each rear quarter-panel on the inside by means of fifty spot-welds. The roof panel is then welded to the rear of the floor pan at twenty-six spots. Next, the roof is joined to the rear quarter-panels on the outside, and the quarter-panels to the floor pan, by seventy-two spot-welds on the left and seventy-two on the right. A total of twelve spot-welds is made in joining the roof panel to the upper parts of the body cowl assembly, and sixty-four spot-welds connect the cowl to the floor pan. Finally, inner and outer roof rails are secured to the roof panel cowl assembly, and body by ninety-seven spot-welds.

The framed body and other welded or stamped sub-assemblies converge at the so-called "body in white" line, seen in Fig. 11, where they are joined together to form the completed unpainted bodies. Doors, fenders, and other parts are added as the bodies move along this line. Torch-, arc-, and spot-welding are all employed, and, as previously mentioned, the fenders are bolted to the quarter-panels. The portable spot-welding guns are supported on beams suspended from a carriage that is pulled along overhead tracks.

* * *

Shot-Blasting Reduces River Pollution

A shot-blasting machine has cut by nine-tenths the amount of sulphuric acid employed to clean forgings at the Buick plant in Flint, Mich., and, at the same time, has drastically reduced pollution in the Flint River. The machine, installed in the drop-forging plant, is used to clean small forgings. A similar machine, for cleaning larger forgings, is on order, and it is expected that the use of sulphuric acid for cleaning will be entirely discontinued by 1953. Installation of the shot-blasting machines is part of a program to eliminate pollution of the river which flows by the plant.

Average Costs Mean Potential Losses

COSTS based on averages are the most dangerous figures in any business, even more dangerous than the dreaded "red" figures, for averages may lead to losses without leaving a trace of the reasons for such losses. They are especially dangerous because it is so tempting to use them. Any other method of figuring costs requires more work, and it is only natural to avoid extra efforts if the need is not apparent. The following discussion may be helpful in arriving at an understanding of this problem, which is of vital importance to manufacturing businesses, particularly to machine shops.

Quite a few machine shops use different hourly rates for different operations, but many employ average hourly rates because they are either not aware of the importance of going into more detail or afraid of the clerical work involved. Actually, the application of an average hourly rate for various operations is justifiable only in a machine shop producing one kind of product or several products that are identical as regards the operations required. Such a shop—it is fair to assume—is extremely rare or wholly hypothetical.

Machine shops that use average hourly rates for different operations are bound to overbid or lose money on a number of jobs because their cost estimates are in error. This is a mathematical necessity. The excessive gains or losses cannot be traced or detected; no statement of profit and loss gives an explanation of them.

How serious these discrepancies may be depends upon various factors. If many jobs of this nature are accepted during the year and if the number of profitable jobs is low, the machine shop in question may show a loss at the end of the year. If, on the other hand, a number of jobs are obtained which, because of the nature of average hourly rates, result in excessively high profits, it might happen that the losses experienced with other jobs would be compensated for and the business would show a profit at the end of the year.

Such profits may lead the owners of the business to the erroneous assumption that the practice of using average hourly rates is sound and safe. If they were aware of the hidden losses experienced with a number of under-priced jobs, they might feel differently. In addition, if they were shown that a number of their quotations were too high (because their average hourly rate included, implicitly, a profit far higher than intended) they might understand the need of improving their operations by better cost-keeping methods.

In the following, an example with fictitious figures will be given to clarify the principles of the problem. A simple method of figuring costs will be described that does not require changes in general bookkeeping methods and may produce the information needed with little clerical work. Table 1 gives the main cost data of a typical machine shop. In order to simplify the problem, the number of operations has been limited and clerical work and office costs have not been included.

In a shop where an average hourly rate is

Table 1. Summary of Yearly Cost Data for a Typical Machine Shop

Operation	Hourly Rate of Pay, Dollars	Productive Hours	Productive Wages, Dollars	Overhead, Dollars	Overhead (Per Cent of Col. 4 to Col. 3)	Wages Plus Overhead, Dollars	Col. 6 in Per Cent	Average Hourly Rate, Dollars
Column No. ...	1	2	3	4	5	6	7	8
Bench Work ..	1.25	24,000	30,000	22,000	73	52,000	17	2.16
Cut Stock	0.80	4,000	3,200	2,400	75	5,600	2	1.40
Lathe	1.25	10,000	12,500	18,500	148	31,000	10	3.10
Milling	1.50	26,000	39,000	123,600	317	162,600	53	6.25
Cyl. Grind.	1.65	6,000	9,900	43,500	440	53,400	18	8.90
Total	....	70,000	94,600	210,000	...	304,600	100	....

to Machine Shops

By B. A. MARGO

employed in figuring costs, it is only necessary to divide total wages plus total overhead by the total productive hours for a given period of time to get this average rate. In the example being considered, these totals are shown in Column 6 ($304,600) and in Column 2 (70,000 hours). The quotient of these two figures is $4.35 per hour.

With this system, the average rate is applied to every cost estimate after the time for each operation has been calculated. For example, if the estimated time for a contract is 15,400 hours, the estimated cost will be 15,400 × $4.35 = $67,000. Based on hourly rates for each operation, however, rather than an average over-all rate, the total actual costs for this contract amount to $99,163, as shown in Table 2.

The actual costs are computed by multiplying the estimated hours by the hourly rates for each operation as given in Column 8 of Table 1. These hourly rates are obtained by adding the productive wages (based on the time spent at a given rate of pay for a particular operation) to the overhead for this operation and then dividing the result by the number of hours spent on the operation.

The explanation for the fact that actual costs are much higher than the estimated ones may be found in the following. Column 7 in Table 1 shows the expense of each operation in percentages of the total expenses for the year. Any job that has the same pattern can be correctly calculated with an average hourly rate; any other job cannot, as may be seen from Table 3, where the percentage of actual costs for the typical contract being considered (Table 2) is compared with the percentage of average costs based on the summary of yearly data, Table 1. The values in the last column are taken from Column 7 of Table 1.

A comparison between the percentage figures in the last two columns of Table 3 indicates that the contract in question required a greater portion of work to be performed in departments with the higher hourly rates than the yearly average shows.

In this example, a loss of $32,163 on wages and overhead alone has to be absorbed. To this must be added lost profit. As mentioned previously, such losses might be recovered by excessive profits on other jobs, as may be illustrated by another example.

A second contract requires 18,800 hours to complete, the distribution of operations being shown in Table 4. Multiplying 18,800 hours by the average rate of $4.35 per hour results in $81,780 estimated costs, which is $34,155 larger than the actual costs of $47,625 given in Table 4. This time, the excessive profit is caused by the fact that the contract requires considerably more work on the bench and less on milling machines than indicated by the pattern of average costs.

Obviously, no objection can be raised if a machine shop is in a position to obtain such profits by taking advantage of favorable market conditions. If such excessive profits, however, are made by chance and without the knowledge of the management, then it can be said that the business is not run as efficiently as possible. It seems to be reasonable to base selling prices on a close estimate of actual costs and to raise or lower the mark-up, if necessary, according to prevailing conditions. Thus, the profit shown at the end of the year becomes the grand total of a number of profitable transactions, and unavoidable gambling, which is part and parcel of any business, may be substantially reduced in one of its most important phases.

A Simple Cost System

The purpose of price estimates is to forecast costs as they will be at the time of actual production. Such a forecast is usually based on past experience; yet it is important to keep in mind that the value of past experience depends upon the nature of the business. If a business is erratic, price estimates require particular care and

Table 2. Cost Estimate for a Typical Contract, Based on Individual Hourly Rates

Operation	Estimated Hours	Actual Costs, Dollars
Bench Work	300	648
Cut Stock	300	420
Lathe	1,000	3,100
Milling	10,500	65,625
Cylindrical Grinding	3,300	29,370
	15,400	99,163

Table 3. Percentage of Actual Costs Compared with Average Yearly Costs

Operation	Actual Costs, Dollars	Actual Costs, Per Cent	Average Yearly Costs from Table 1, Per Cent
Bench Work..	648	0.6	17
Cut Stock	420	0.4	2
Lathe	3,100	3.1	10
Milling	65,625	66.3	53
Cylindrical Grinding ...	29,370	29.6	18
	99,163	100.0	100

a close study of working conditions as they may be expected to be when a new contract goes into production. Under such conditions, which may be found in numerous job shops, the uncritical use of past cost figures might be misleading.

In many other job shops, which enjoy a relatively steady level of production, past figures may be used with greater confidence and security. It seems feasible and advisable in such shops, to maintain a simple cost system in order to establish hourly rates per operation or group of machines. How much clerical work will be necessary to maintain such a system depends upon the actual operating conditions of each individual shop.

It is important to run such a system for a period of six to twelve months with a relatively high degree of accuracy and refinement. Then a study of the accumulated data should be made. This may reveal that certain simplifications are permissible. For instance, in the beginning, overhead expenses for lathes and drill presses, say, should be recorded separately. If experience over an extended period should show that the hourly rates are nearly identical, these two groups of machines may be put together.

Table 4. Cost Estimate for Another Contract Showing Comparison of Actual Costs and Average Yearly Costs

Operation	Estimated Hours	Actual Costs, Dollars	Actual Costs, Per Cent	Average Yearly Costs from Table 1, Per Cent
Bench Work	10,000	21,600	45	17
Cut Stock..	5,000	7,000	15	2
Lathe	1,500	4,650	10	10
Milling	2,300	14,375	30	53
Cylindrical Grinding..	.....	......	..	18
Total.....	18,800	47,625	100	100

Eventually, it may be possible to restrict the whole overhead control to four groups, as, for example, hand operations and light, medium, and heavy machines. It is of the utmost importance, however, to introduce such simplifications only after accumulating detailed data and ascertaining that the simplifications have no adverse effect upon the final result as shown in cost estimates. An inaccuracy within known limits is permissible, but if its extent is not known, the results may be detrimental.

Table 5 illustrates a monthly control sheet which may be used for recording overhead expenses by machine groups or departments. The items listed in this table may be broken down as follows:

Indirect Material—Cleaning, lubricating, wrapping, printing and stationery, tools, safety appliances, paint and chemicals, etc.

Indirect Labor—Holidays and vacations, waiting, training, sickness pay, etc.

Special Expenses—Lost material and labor, changes and trials, samples, etc.

Monthly Expenses—Advertising, bank charges, charity, electricity, gas, etc.

Yearly Expenses — Depreciation, insurance, interest on investment, rent, business taxes, reserve for major repairs, etc.

The items under the heading "Yearly Expenses" are fixed for a relatively long period of time and do not require any work after they have once been established. The item "Depreciation" requires explanation. Depreciation of machinery and equipment as used for cost purposes has very little to do with depreciation applied under tax regulations. The essential viewpoint in determining the rate of depreciation for figuring costs is the estimated life of the machine or the equipment in the shop. This estimate has to be based on its use as well as on the technical trend. The constant monthly depreciation rate should be maintained as long as the machine is not replaced. This is essential in order to avoid fluctuations in costs which are not justified.

The expenses under all the other headings are represented by vouchers of various types—material requisition slips, work slips, invoices, etc. All these vouchers have to be marked with the appropriate account number. The account number is a combination of two figures—one indicating the department, and the other the expense item. That is, 1-4 may indicate stationery used in the office, 11-4 stationery used in the stockroom. The simplest and fastest way of establishing the totals per account is to add up the amounts by means of an adding machine. The

Table 5. Monthly Control Sheet for Recording Overhead Expenses by Machine Groups or Departments

Acc. No.	Item	Total	Office 1	Stock-room 11	Bench Work 21	Cut Stock 22	Lathe 23	Milling 24
4	Indirect Material							
11	Indirect Labor							
21	Special Expenses							
31	Monthly Expenses							
51	Yearly Expenses							
	Total..................							

totals per account number are entered in the monthly control sheet.

At this time, it is worthwhile mentioning that the amount of work connected with writing the monthly control sheet is usually overestimated. It may be expected, at first glance, that a figure has to be entered into each of the hundreds of squares. This, however, is not the case. Not every expense item is needed in every department, and many expense items occur only from time to time.

Obviously, the total shown on the monthly control sheet has to be reconciled with the corresponding total shown in the books. With this control, it is possible to do away with fine subdivisions of accounts in the books, which are maintained in order to give management the same information as is furnished in the monthly control sheet.

This leads us to another important function of the monthly control sheet. It is the most effective means of controlling actual overhead expenses on a monthly basis. For example, one copy of the sheet can be cut into strips covering each department and the strips pasted on a sheet of paper for each department every month. Thus, management may easily compare the actual expenditures for every overhead item of each department, which may be useful in detecting unfavorable trends.

After six to twelve months, the next logical step is to use the information contained in the monthly control sheets for establishing budgets by account number and department. Such budgets are valuable in keeping actual expenses under control and in establishing costs. They may serve as a basis of incentives for supervisors. Thus the monthly control sheet can become an indispensable tool, and the cost of maintaining it is usually negligible.

The National Standard of Mass

As the custodian of the national standards of physical measurement, the National Bureau of Standards not only sets up and maintains the basic standards of length, mass, time, and other physical quantities, but also undertakes the required research leading to improvements and refinements in such standards and measurement methods. For example, the national standard of mass—a platinum-iridium cylinder about 1 1/2 inches high, 1 1/2 inches in diameter, and having a mass of almost exactly one kilogram—is maintained in a special vault, and is a copy of an international standard kept at the International Bureau of Weights and Measures at Sevres, near Paris, which is known as Prototype Kilogram No. 20. It was established as the national standard by executive order in 1893.

Since that time, the pound and other everyday units of mass have been defined by the ratio of their mass to the mass of this kilogram. Occasionally the national standard kilogram is removed from the vault to check the best secondary standards. These secondary standards include other platinum-iridium standards from 1 kilogram to 0.05 milligram and two 1-kilogram standards of nickel-chromium alloy. From these standards, values are derived for the working standards in the various customary and metric units used in everyday testing in the Bureau's laboratories.

* * *

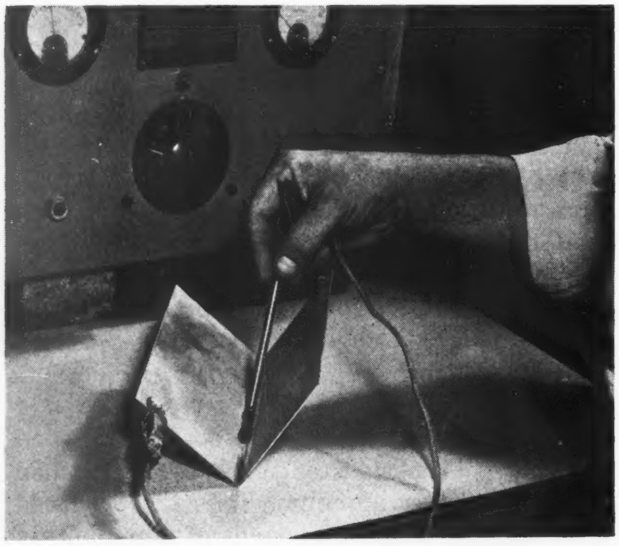
During peak periods of World War II, when the United States aluminum industry produced more than 2,250,000,000 pounds of aluminum in a year, more electricity was consumed for aluminum production in one day than would normally be used by a city of 60,000 homes in a year.

Engineering News

Removing Weld Discoloration from Stainless Steel

A new method of removing weld discoloration from stainless steel has been developed by the Research Division of the Armco Steel Corporation. The equipment consists principally of a copper rod, about 1/4 inch in diameter, bent to a convenient shape; short pieces of rubber tubing placed on the rod to keep it from touching the stainless steel and causing a short circuit; a power source; and a small amount of acid solution. The copper rod is connected to the negative terminal of a direct-current power source and the stainless-steel part to the positive terminal. After the acid solution has been applied to the weld area, the copper rod is passed along the joint to be cleaned at the rate of about 2 feet per minute, with the result that weld discoloration is quickly removed.

The solution generally used is 50 per cent phosphoric acid. Nitric or hydrochloric acid can be employed, but will etch the surface more than phosphoric acid. With nitric acid, it is necessary to use a stainless-steel instead of a copper rod. Direct current of about 6 to 9 volts and 5 to 6 amperes is required for each square inch of rod in contact with the acid. The most satisfactory cleaning is accomplished by using high current densities and cleaning small areas at a time, using more than one pass of the rod if necessary.



Cleaning discoloration from stainless-steel weldments by connecting the part to a power source, applying an acid solution to the weld area, and passing a copper tool along the weld

Storage batteries, rectifiers, and low capacity direct-current welders can be employed as power sources. For cleaning flat areas, a flat copper strip wrapped with acid-dampened asbestos or glass cloth is used instead of the copper rod. The method of cleaning is the same.

This novel cleaning method removes light scale and discoloration only. Heavy deposits should be removed by chipping or brushing before the cleaning tool is used.

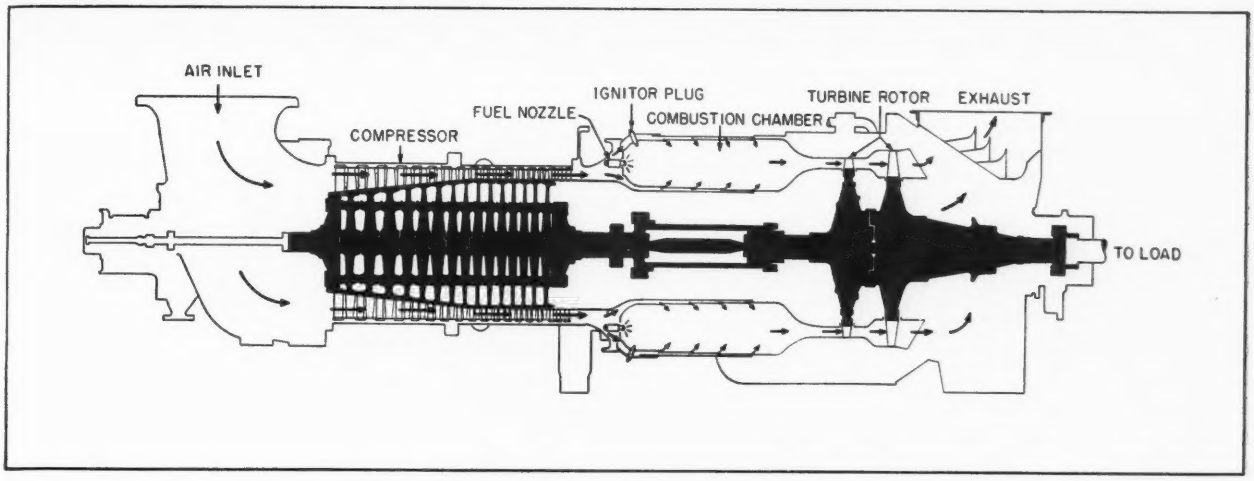
Working Stainless Steel at Minus 300 Degrees F. Increases Hardness

Following up an unexpected result from routine tests—the presence of magnetism in a fractured piece of stainless steel—has led to a new process by means of which this metal can be made about 100 per cent harder than has been possible by conventional metal-working procedures. Impact tests on cast stainless steels were conducted at the temperature of liquid nitrogen (about 300 degrees F. below zero). After the tests had been completed, one of the samples, which had returned to room temperature, exhibited a strong magnetic effect near the fracture. Other samples broken at room temperature displayed none of this magnetism.

Subsequent tests showed that temperature alone was not a factor. Apparently the increase in permeability had been caused by a combination of the severe plastic deformation—caused by the impact tests—and the low temperature.

Tests made with the broken impact samples showed that the hardness adjacent to the fracture had increased over that in the "as cast" condition by two or three times. This discovery was the basis for intensive cooperative studies by the Crane Co. and Westinghouse Research Laboratories on the effects of rolling and drawing at sub-zero temperatures.

Some of the best results were obtained by a short period of heat-treatment at about 2100 degrees F.; quenching in water; cooling to about —300 degrees F.; rolling the metal while at that temperature from 1/4 to 1/16 inch; and then aging for several hours at about 750 degrees F. Significantly, the highest hardness and strength values were obtained in those specimens rolled at the lowest temperature. Tensile strength, yield stress, and hardness were all increased by this process as compared to conventional rolling.



Air flow diagram of the gas turbine employed for electric locomotives

Of particular interest was the increase in proportional limit, which proved to be more than double that obtained by rolling at room temperature. Torsional yield stress and fatigue strength were also increased by about one-half. The process is being referred to as "Zerolling."

One sample tested showed an even more remarkable characteristic. Austenitic stainless steels worked by conventional methods have a very low wear resistance, as compared to the best wear-resistant metals, such as certain of the cobalt-chromium-base alloys that are frequently used because of their excellent resistance to wear under sliding friction. Yet one of the specially processed stainless-steel specimens, differing slightly in composition from the others, showed a wear performance equal to, or better than, the best wear-resistant metal combinations.

"Intelligent" High-Altitude Balloons

Balloons that know just how high they are—and that can take themselves from one height to another—were developed in the meteorological laboratories of the Research Division of New York University College of Engineering last year. To make accurate measurements of temperature, pressure, and other factors involved in weather studies and cosmic ray research, scientists needed some method of keeping instruments at a given altitude for long periods of time.

The balloon systems designed by the Division have stayed aloft for as long as forty-eight hours, remaining within 1000 feet of a given altitude. Some of them have carried instruments to one height, remained there until measurements were made, then carried them to another altitude for further measurements. One balloon released by the Division crossed the Atlantic Ocean.

Gas Turbines Provide Compact, Powerful Drive for Locomotives

Ten gas-turbine electric locomotives—the newest form of rail motive power—have been ordered from the General Electric Co. for regular freight service on the Union Pacific Railroad. These compact, powerful locomotives will be similar to a 4500-H.P. unit which has been undergoing tests for the past 1 1/2 years.

The gas-turbine power plant is similar in principle to the power plant in jet engines except that there is no jet effect, as in a plane. In the locomotive, the turbine is connected through reduction gears to electric generators. An air flow diagram of the gas turbine is shown above.

The gas-turbine electric locomotives outwardly resemble a straight electric locomotive in appearance. They require virtually no water, have few moving parts, and use low-cost "Bunker C" oil as fuel. The locomotives will be geared for freight service and have a top speed of 65 miles per hour. The running gear for each locomotive will consist of four two-axle trucks, each truck being equipped with two traction motors.

3000-H.P. Electric Motor Measures only 36 Inches in Diameter

A large motor of unusual design was recently built by Westinghouse Electric Corporation for service in an aviation laboratory. Since maximum capacity and small size were essential, the motor is only 36 inches in diameter, yet develops 3000 H.P. for half-hour intervals. It is a two-pole motor operating on a 120-cycle supply. The rotor is a solid forging having a cage formed by bars driven into slots cut in the steel. Retainer rings were made of "Discaloy," a high-strength metal developed primarily for jet-engine disks.

Fifty Years Pioneering in

MODERN production lines in industrial plants turning out products made from metal are seldom found without batteries of multiple-spindle drilling machines. The history of multiple-spindle drilling is interwoven with that of the National Automatic Tool Co., Richmond, Ind., which this year celebrates its fiftieth anniversary. It was in 1901 that a group of six men from the National Cash Register Co. developed a new type of drilling machine with multiple spindles, and formed a new organization, which has grown into what is believed to be the largest builder of multiple-spindle drilling and tapping equipment in the world.

A cash register served as a guinea pig to make possible some of the earliest attempts at multiple-spindle drilling and tapping. One of the early jobs consisted of drilling and tapping a multiplicity of holes in cash register side plates. Fig. 1 shows four of a line of six of the early machines as they look today, still at work on parts for modern cash registers. Of course, the machines have been repaired and renewed through the years, but their basic design makes them highly productive even today.

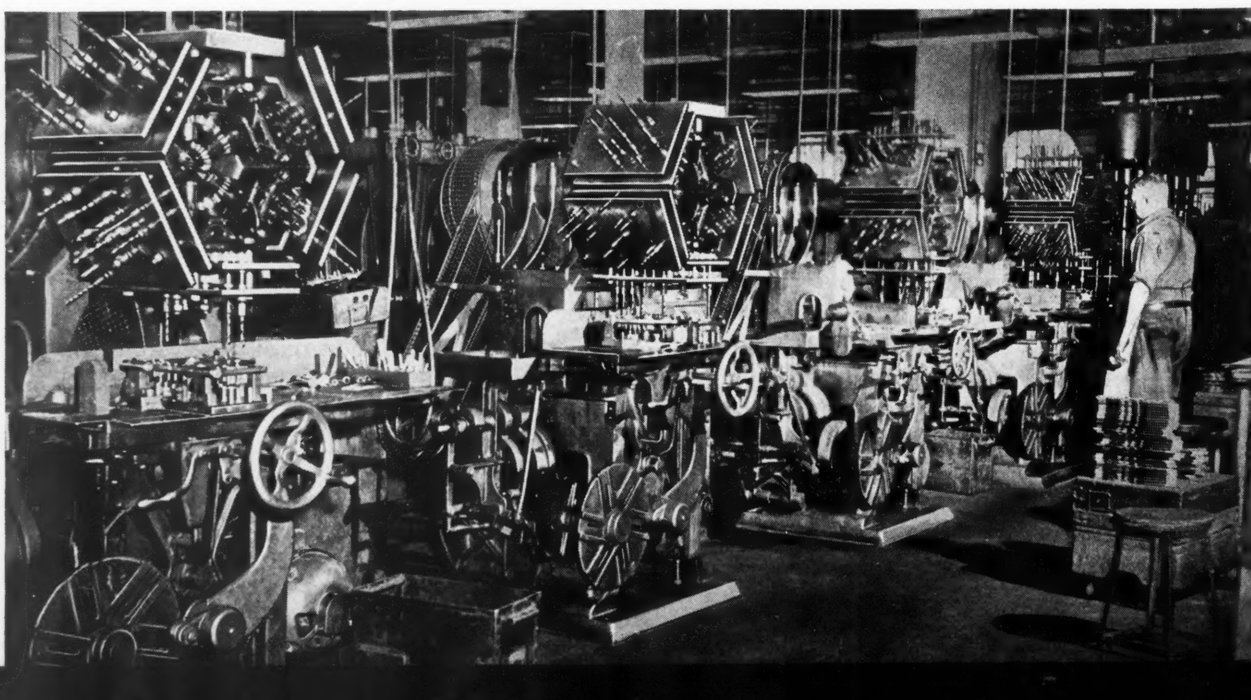
At the start of operations, the National Automatic Tool Co. was located on the third floor of a building in Dayton, Ohio, and occupied 3500 square feet of floor space. Mr. Stevenson, who held the patent for the independent change of speed for each spindle, was president of the company, and Mr. Nutting, who introduced the Type A machine with the hexagon head, was vice-president. Although the concern had the skill required to build good machines and unusual abilities for machine design, it was not until 1908, when William F. Bockhoff acquired control, that the company was able to capitalize fully open its mechanical inventiveness.

In 1910, the plant was moved to Richmond, Ind., into a much larger building, but at the beginning only part of the first floor was occupied. After several years, the entire building, containing 24,000 square feet of floor space, was occupied. In the late twenties, after four successive expansions, 116,000 square feet of floor space was in use. New plant expansions in 1943 added several thousand square feet of assembly and shipping space. Today, new buildings are nearing completion that will provide for engineering and welding expansion, and the entire plant will soon comprise 254,000 square feet of floor space.

In addition to the hexagon head and the independent change of speed for each spindle, many features of multiple-spindle drilling machines, down through the years, were developed by Natco engineers; for example, slip spindle plates, by means of which multiple-spindle drilling machines could be adapted to production of many different parts simply by adding a new plate to the machine with the proper sizes of spindles and individual spindle speeds. Another development was a fixed-center spindle box, which is still extensively used in mass production.

Natco also pioneered in the use of indexing tables to permit an operator to load and unload work-pieces while machining operations are being performed. Another development of Natco

Fig. 1. Line of original Natco multiple-spindle drilling machines with hexagon heads as they appear today producing cash-register side frames at the rate of sixty per hour



Multiple-Spindle Drilling Machines



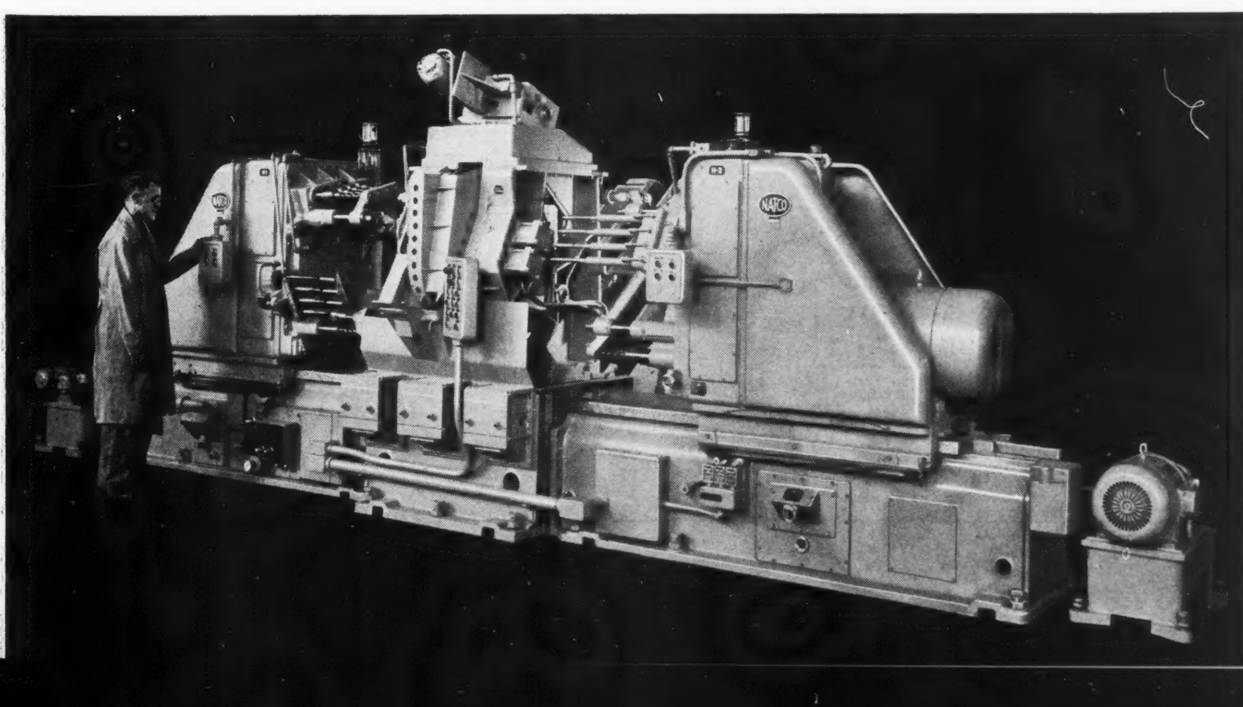
(Left to Right) Harry W. Bockhoff, chairman of the board and president of the National Automatic Tool Co., Inc., which is celebrating its fiftieth anniversary this year; Edward D. Frank, vice-president, director, and sales manager of the company; Erma B. Hunt, operating vice-president and director

engineers was multiple tapping with individual lead-screws for each tap. Also, the company was an early user of hydraulic feeds for multiple-spindle drilling.

Harry W. Bockhoff was made vice-president and general manager of the National Automatic Tool Co., Inc., in 1924, and on the death of his father in 1928, became president. The year after the company moved to Richmond, Edward D. Frank became chief engineer, and shortly afterward, was made plant superintendent. A few years later, Mr. Frank became sales manager, a position he still holds; in addition, he serves as vice-president and a director of the company.

R. C. Schuerman came to Natco in 1928 as supervisor of the accounting department, and in 1937, was elected treasurer and director. Erma B. Hunt has taken an active interest in the company, particularly since the death of her father, William F. Bockhoff. She has been a director since 1929, and was elected operating vice-president of the company in 1940. The secretary of the concern is Allen B. McCrea, who came to work for Natco in 1937 and was elected secretary the following year. In 1940, Mr. McCrea was made supervisor of cost reduction. From 1944 to 1946 he was in the Army. Upon returning to the company, he became factory manager.

Fig. 2. Three-way trunnion type of multiple-spindle drilling machine, which is typical of Natco's products today



Preparing Plate Edges

IN preparing plate for production welding, it is often desirable to use various types of edges. The type of edge to be employed varies with the thickness and type of material, method of welding, type of joint, and angle of adjoining plates. The edge profiles shown in Fig. 1 illustrate the kinds most frequently encountered in plate welding. The butt joint edges shown include the simple square edge *A*, single-vee *B* and *C*, double-vee *D*, single bevel *E* and *F*, and the more complex double-bevel and nose edge *G* and single J illustrated at *H*. The principal methods of producing these surfaces employ various types of oxygen cutting equipment.

In order to insure uniformity of the cut surfaces, it is necessary to employ either machine-carried cutting apparatus, which travels along a straight-line track or accurately follows a prescribed path, or a fixed apparatus, the material being moved in a suitable manner. In making all beveled cuts, the blowpipe or nozzle must be supported on a roller arrangement, which contacts the plate as close as possible to the reaction zone. The vertical location or clearance of the nozzle above the plate surface is therefore controlled by the floating mechanism, which rides on the plate at a fixed distance from the machine as it moves along the track.

One of the more elementary types of edge preparation equipment is illustrated in Fig. 2. Here a portable cutting machine is shown with a single blowpipe and nozzle located in a position to produce a square cut at the edge of the plate. This equipment can also be used for producing beveled cuts on short sections of plate by tilting the blowpipe to the desired angle or by using a bevel cutting adapter in a vertically positioned blowpipe. However, this set-up should be provided with a plate-riding device whenever long cuts of close accuracy are required.

If a double bevel and flat nose are to be produced on the plate edge, it will be necessary to use a nozzle arrangement capable of handling three or more nozzles in an adjustable cluster. In one such arrangement, Fig. 3, the first nozzle is an auxiliary cutting nozzle, which produces a leading under-bevel cut in the scrap material. Bevel cutting requires greater preheating than square cutting because of the lower angle of impingement of the flames on the plate surface and the greater length of reaction zone due to the fact that the cut penetrates at an angle through a given thickness of plate.

The second nozzle produces the desired under-bevel plane of the edge profile. It is displaced sidewise in relation to the first or leading nozzle by approximately 1/4 inch, and is 2 inches behind the leading nozzle, so that the second reaction zone is carried through material preheated by the leading reaction zone. The cut surface produced by the leading nozzle is unimportant, and may be rough, as in the case of cutting at high speed with insufficient preheating, but the lower surface of the second cut must be smooth and uniform. The third nozzle in the group, which also cuts through heated material, produces a square cut. The lower part of this cut becomes the nose of the double bevel profile.

The thin section of metal left between the first and second cuts is easily penetrated by the square

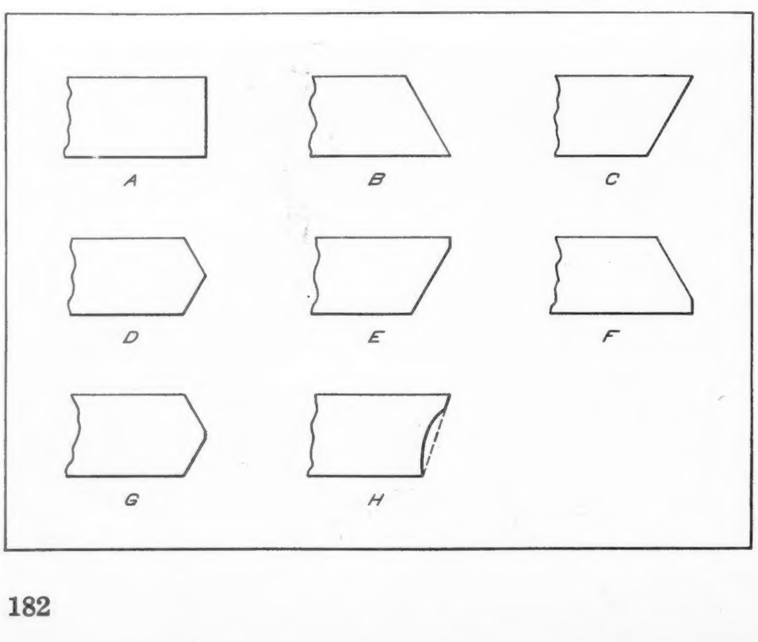


Fig. 1. Typical edge profiles produced on plates in preparation for production welding. These butt-joint edges progress from the simple square edge seen at (A) to the more complex single J edge shown at (H)

for Production Welding

By
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Fig. 2. Portable cutting machine with single blowpipe and nozzle located to produce a square cut at the edges of plates

cutting nozzle reaction zone, so that the slag from the latter jumps the gaps and falls out through the bottom of the plate. The top surface of this edge profile is produced by the fourth nozzle, which cuts through solid material from the top side of the plate and exhausts through the pre-heated scrap material.

The beveling angles of the nozzles can be accurately adjusted by rotating the nozzle-holders in the squeeze clamps. Also, the sidewise displacement of the nozzles can be accurately controlled by adjusting cross-feed screws. The distance, along the line of cut, between the beveling nozzles and the squaring nozzle should be adjusted to a minimum. This will bring the nozzles close to the plate-riding wheel and assure accuracy of the beveling reaction zones.

However, the amount and tenacity of the slag adhering to the cut edges must be considered. To control the slag, the distance between nozzles sometimes may have to be increased. This will permit the material to cool below the critical temperature at which the slag tends to fuse into the underlying kerf surface.

As the cut progresses along a prescribed line, the material along the length of the cut is heated by the reaction zone. A piece of steel that is heated along one edge tends to bow due to expansion from the heat. This bowing tendency is resisted by the mass and stiffness of the material between the heated edge and the opposite side. In short sections, the bowing is negligible, but in long narrow sections, it is more pronounced.

For example, cutting along a straight track on one side of a plate 1/2 inch thick by 7 feet wide by 37 feet long will cause the trimmed side to bow outward about 1/16 inch at the mid section. As this section of the plate edge cools down to room temperature, the heated material that was compressed or upset by the resistance of the remainder of the plate shrinks to less than the original length. This causes the material along the edge to become stressed in tension, and the plate takes a set with an inward or concave bow of about 1/16 inch.

While a plate 37 feet long with only 1/16 inch out-of-straightness along one edge would appear to be straight enough, two such plates, placed edge to edge, will have a 1/8-inch gap along the mid section. This means that weld materials and time will be wasted in filling in the gap during the welding operation.

Such a condition is very much greater in the case of thinner or narrower plates. Whenever excessive bowing is anticipated, it is well to consider cutting the opposite sides simultaneously. This insures the introduction of equal amounts of heat on each side.

One of the most accurate plate edge preparation set-ups and one most suitable for high production rates is that known as a "flame planer." With this type of equipment, the opposite sides of the plate are cut simultaneously, and the ends may be cut at the same time or separately, depending upon the completeness of the flame planer set-up. A complete flame planer consists

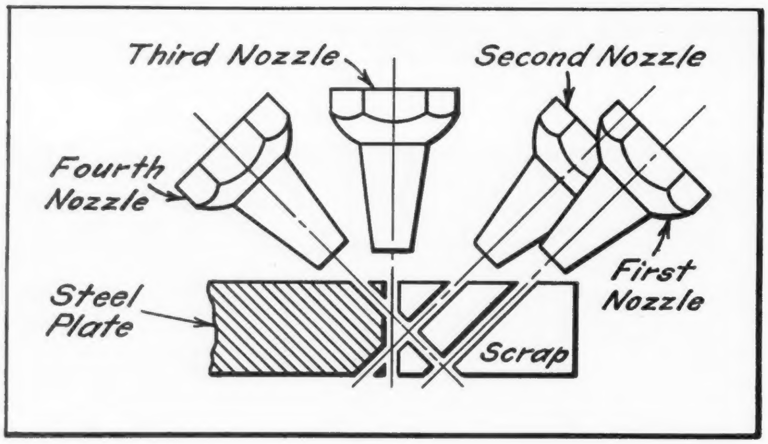

Fig. 3. Four-nozzle arrangement for producing a double bevel and flat nose on the edges of steel plates

of three carriages, or gantry units, extending across the cutting bed and riding on a continuous pair of accurately machined and located tracks or rails. The center carriage makes the two side cuts simultaneously and the end sections are cut by machines which travel across the first and third gantries. The end cutting operations are arranged so that there will be no interference of carriages, and their timing will depend upon the size and shape of the plate sections.

The rate of production of a flame planer is not only a function of the cutting speed, but also depends on the loading and unloading rate of the cutting table. In order to facilitate loading and removal of the plate and avoid delays due to interrupted crane service, a roller type of cutting table is generally employed. Fig. 4 shows a view of a large plate-cutting installation in the Kaiser Shipyard, Richmond, Calif., during a period of high-rate ship production.

Plates are loaded on the far end of the flame planer roller table and unloaded from the end seen in the foreground, after they have been cut to size, with the required edge preparation. Supporting frames of the cutting bed are separated from the loading and unloading ends to avoid jarring the bed and permit loading and unloading while cutting.

A straight-line, gantry type plate-edge preparation unit or flame planer, Fig. 5, was made by the Mosher Steel Co., Dallas, Tex., to suit their own requirements. The gantry carriage spans

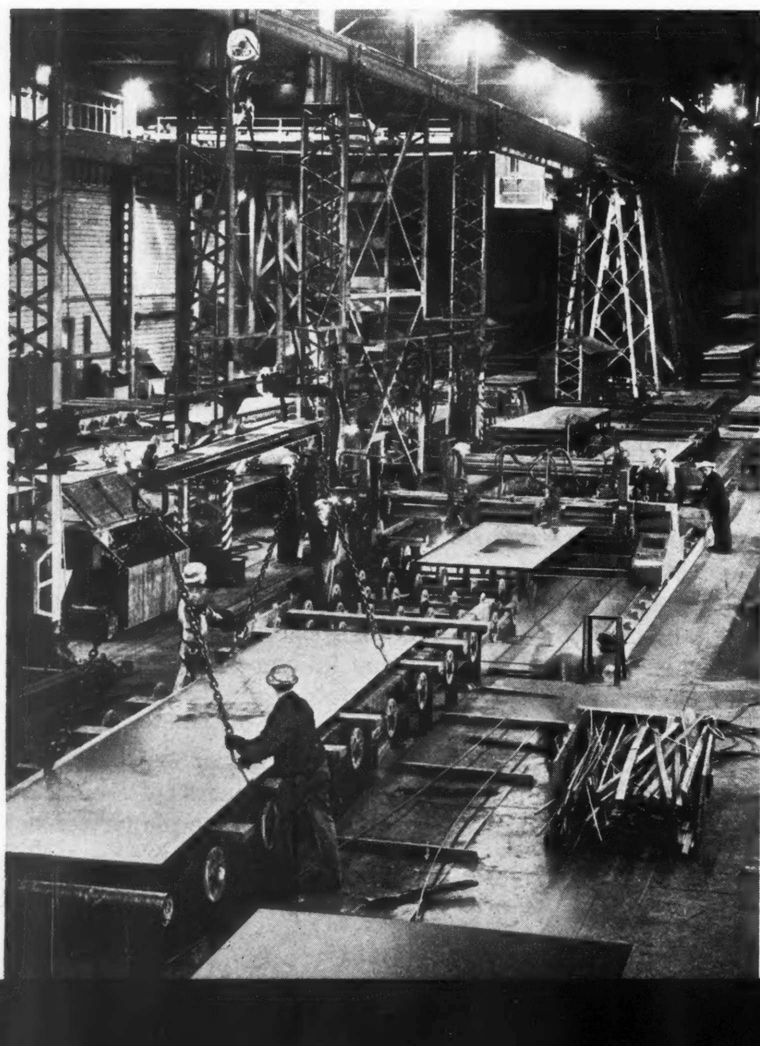

Fig. 4. View of a large flame planer type of plate cutting installation used in a shipyard to cut and edge plates prior to welding

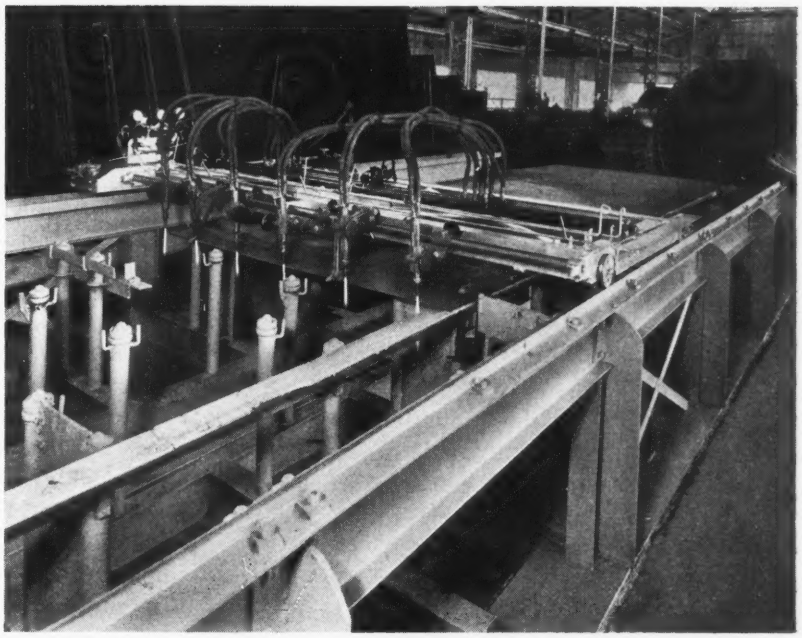

Fig. 5. Straight-line, gantry type of plate-edge preparation unit or flame planer for producing various edges on steel plates

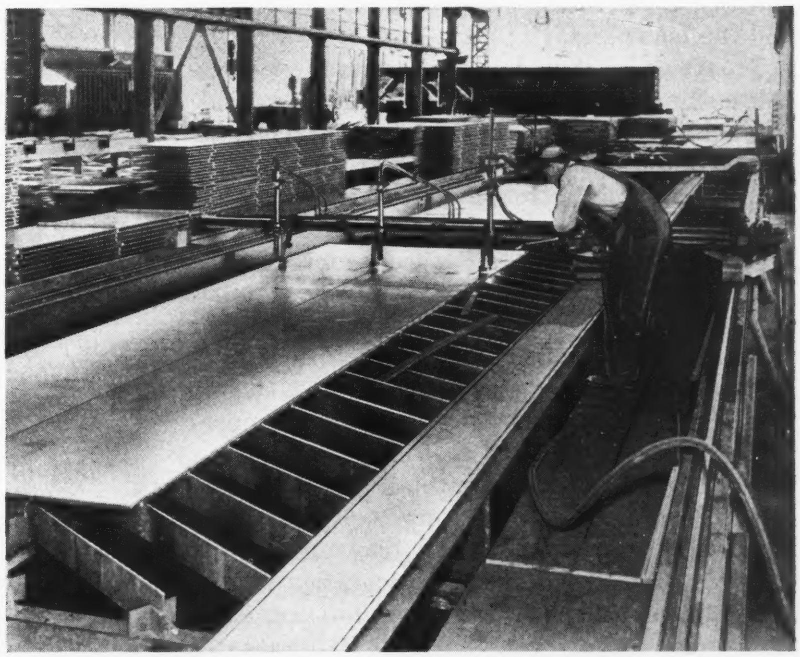

Fig. 6. Steel plates, 1/2 inch thick, are cut into two equal-width sections at the rate of 26 inches per minute by the use of this gantry type, plate-edge preparation unit

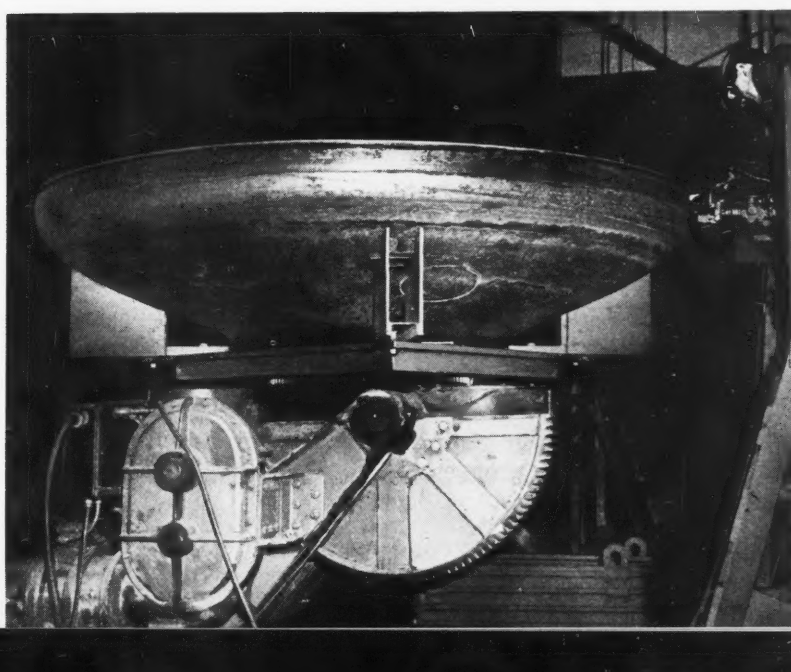

Fig. 7. Edge of a dished head, which is mounted on a standard welding positioner, is formed by rotating it past a standard plate-edge preparation unit

the work area and travels on parallel tracks, which extend the full length of the work-table. On one side there is a monorail, and on the opposite side a double track for standard cutting machines.

The gantry carriage is driven by a standard cutting machine, which is built into and supports the carriage at one corner. The other three corners of the carriage are supported on roller- or ball-bearing mounted wheels riding on the inner tracks. The cutting machine driving wheel is also rigidly connected through a shaft to the driving wheel on the monorail side.

A number of cutting blowpipes are mounted on the cross-bar which extends across the entire width of the carriage. The cross-bar is equipped with a continuous gear rack which facilitates adjustments of blowpipe spacing. All blowpipes can be used for squaring cuts or plate-slitting, but only the blowpipes in the plate-riding brackets can be used for beveling, in which case bevel-cutting adapters are inserted between the nozzles and the blowpipes.

Square or bevel cross-cuts are made by a portable cutting machine mounted on a track extending across the front side of the carriage, as shown in the illustration. The gas-supply hoses are restrained in a trough which keeps them off the floor and reduces drag on the machine. Gas regulators and control valves are mounted on the machine to facilitate operator control. A number of swinging arms locate the work-piece from the monorail side of the set-up.

On another flame planer, built by the Newport News Shipping and Drydock Co. to meet requirements for edge preparation of extra wide plates, the bridge carriage movement is powered by a 1/2-H.P. direct-current motor equipped with Thymotrol speed control and magnetic clutch. This gives steady, dependable operation at any speed between 3 and 30 inches per minute. Rack and pinion engagement on both rails assures that the wide carriage will remain square with the rails as it moves forward or backward.

A gantry type plate-edge preparation unit made by Gilmore Fabricators of Oakland, Calif., is shown in Fig. 6. In this set-up, shape-cutting machine tracks and wheel assemblies and standard cutting machine units are used. Three vertical blowpipes, individually supported by plate riding attachments, are shown splitting a long, 1/2-inch thick plate into two sections of uniform width at a cutting speed of 26 inches per minute. The gantry carriage rides on an inverted vee section at the right side and a flat rail at the left side. The operator is cutting up the scrap trimmed from the edge of the original plate as the longitudinal cuts progress.

The driving wheels of the standard cutting machine unit contact a narrow runway of light steel plate attached to the right side of the cutting bed. The cutting bed consists of bars of light steel plate, uniform in width, which are held in a vertical position by the brackets of angle-iron sections welded to the foundation structure.

A cross-cutting carriage unit, independent of the main gantry carriage, rides on the same rails with similar wheel assemblies. Square or bevel cross-cuts can be made with this portable cutting machine, which rides on a straight track extending across the inverted channel member of the gantry carriage.

In connection with the assembly of pressure vessels and liquid storage tanks, a large number of dished heads are used. These heads vary in size, shape, and diameter to suit design requirements. Welding operations necessitate normal edge preparation, and to meet this need, standard plate-edge preparation equipment has been installed in several cases. Fig. 7 shows a dished head mounted on a standard welding positioner in such a manner that the edge of the head can be rotated past a standard plate-edge preparation unit. This unit has a spring-loaded, roller-bearing guided column mounted in a horizontal position, with a plate-riding wheel contacting the dished head, so that a bevel and flat-nose edge profile can be formed around the edge of the head.

Other installations for oxy-acetylene edge preparation of these heads include the use of portable machines operating around a pivot post located within the head and special plate-edge preparation units mounted on centrally located pivot arms.

* * *

Automobiles Promoted Use of Nickel as an Alloy

The automobile industry and the United States Navy were the first large-scale users of nickel, which less than a century ago was regarded mostly as a nuisance. According to *Automobile Facts*, there was almost no demand for nickel until the early 1900's, when the Navy learned of its value in making superior armor plate. Nickel was not extensively used until about the time of World War I, when the automobile industry was developing tougher steels for engine parts, gears, and shafts. The United States leads the world in nickel consumption, but must import 99 per cent of its supply. Much of the raw nickel is found combined with copper in such a way that it is difficult to separate the two metals.

Flame-Hardening as a Versatile Production Tool

Selective Hardening by the Oxy-Acetylene Process is a Fast and Economical Way of Heat-Treating a Wide Variety of Parts. The Flame-Hardening of Lathe Bed Ways, Described in This Article, is a Typical Application

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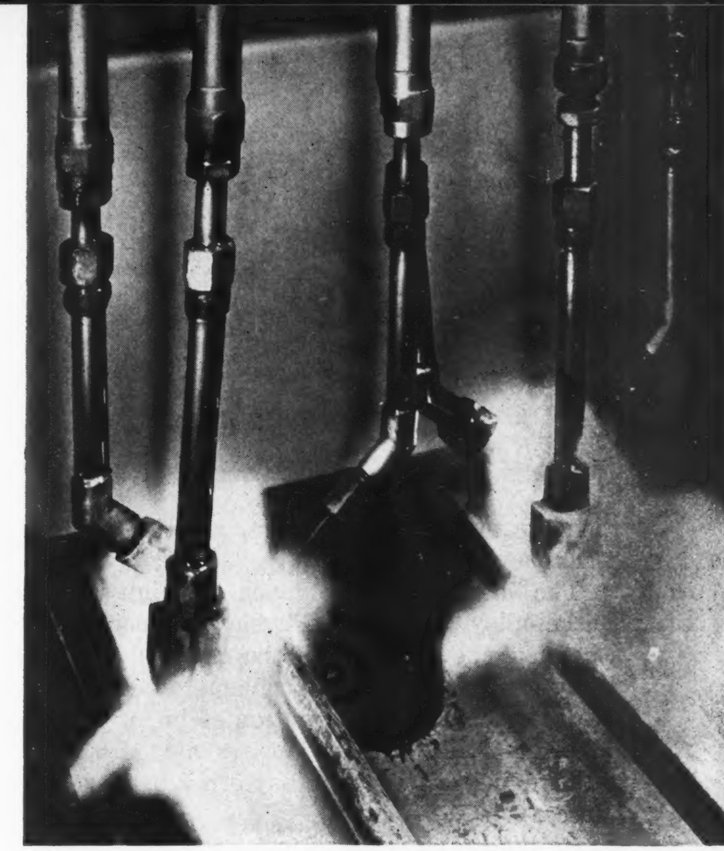


Fig. 1. Flame-hardening a lathe bed with six torches operating simultaneously

TO metallurgists, engineers, and heat-treaters, flame-hardening is far from new as a production heat-treating technique. That the flame-hardening technique has found so many uses during the last thirteen years and still continues to find important new applications in many industries can be traced directly to the numerous advantages it provides.

First of all, the flexibility of oxy-acetylene flame-hardening makes it applicable to a variety of shapes—large or small—in production work or single operations. Mechanical and structural parts of machinery and equipment impossible or impracticable to handle by furnace hardening methods can be surface-hardened quickly and economically by this process. The ability to limit hardness to shallow surfaces without affecting the desirable properties in the underlying core metal, however, undoubtedly represents the greatest single attribute of the process. In contrast to through hardening, this permits selective hardening, as the flames are directed to localized areas only.

Because of this selectivity, heat requirements are held to a minimum. It is therefore possible to achieve maximum physical properties in the material treated—that is, to combine a wear-resistant hard surface with a tough core. Whereas furnace methods are more economical for the uniform hardening of small parts produced in volume, flame-hardening proves particularly adaptable to hardening small areas of large parts, especially when a high degree of hardness is essential.

Combining the simplicity of hardening by heating and quenching with the features of case carburizing, flame-hardening leaves a tough, ductile core which is resilient and resistant to shock. With hardness localized where it is needed, it is often possible to produce higher surface hardness on a given steel by the flame-hardening method than can be obtained by furnace heating followed by quenching.

Time saving is another important advantage. The flame-hardening process involves a relatively small portion of the time required for furnace hardening; and because of its speed, parts are left in a nearly pit-free, scale-free condition. Hence, subsequent descaling costs are eliminated. Distortion is minimized, and since finished surfaces frequently can be flame-hardened, substantial savings in machining and grinding can also be effected. Still other factors favoring the flame-hardening process are the simple, inexpensive equipment required and the fact that, with an assortment of standard torch heads or tips, many different types of jobs can be handled.

Applications of flame-hardening in the manufacture of machine tool parts have steadily increased in recent years. The production of lathes at the Monarch Machine Tool Co., Sidney, Ohio, may be cited as a typical illustration. Here the process is used for hardening such lathe com-

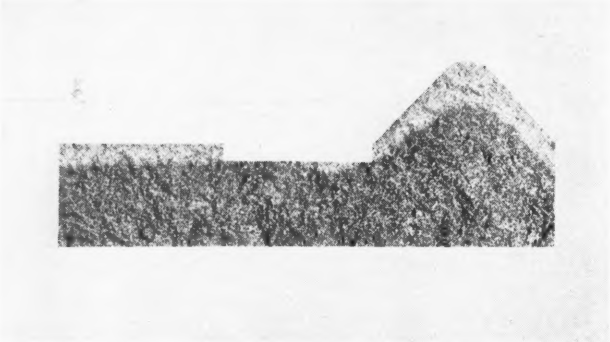


Fig. 2. Unretouched photograph of a section through a lathe bed, showing the hardness pattern that is achieved by flame-hardening

ponents as bed ways, gears, and the teeth of racks and clutches.

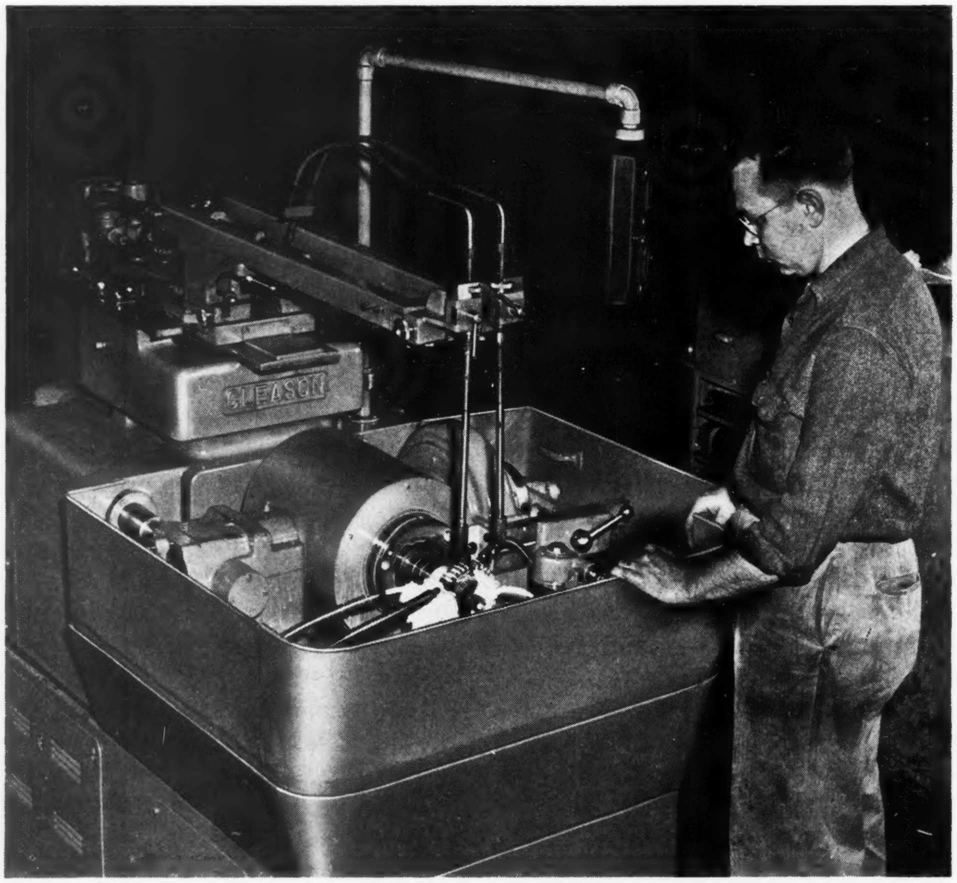
The lathe beds are made of high-strength nickel-alloy cast iron. Physical properties and chemical specifications of the material are carefully controlled, as the problems of degree and depth of hardness, prevention of burn, and prevention of decarburization are much the same in flame-hardening as in any other heat-treating process.

Both flat and vee surfaces are handled with a six-torch set-up in which the flame is passed over the work, Fig. 1. The six torches are operated simultaneously, two for each of the two vees and one for each flat surface. The flat surfaces of lathe bed ways may range from 1/2 inch to 8 inches wide.

The heating effect of each torch must be carefully regulated, since the speed of travel over the lathe bed is necessarily the same for all torch units. This heating effect is controlled by varying either the intensity of the flame or the distance of the flame from the surface being heated, or both. The range of speed of torch travel in the progressive hardening of bed ways depends upon the section sizes. The length of the bed section is limited primarily by the size of equipment available for hardening.

The type of torch used is rather simple, consisting of a flame zone followed by a water quench. The water not only cools the torch equipment, but also quenches the heated piece to produce the hardness desired. Following flame-hardening, the bed ways are surface-ground. A subsequent hardness check with a Shore Scleroscope shows an average rating of 70 to 80. The depth of the hardened section varies from 1/8 to 1/4 inch, depending upon the

Fig. 3. Gleason surface-hardening equipment employed for flame-hardening gears at the plant of the Monarch Machine Tool Co.



type of bed and the lathe on which it is to be used.

These cast-iron alloy bed ways acquire many desirable characteristics when flame-hardened. There is a gradual blend of the hardened layer, which has a martensitic structure, into the tough under body of the fine pearlitic iron (Fig. 2), resulting in way sections that have high wear-resistance and still retain the advantages of remaining an integral part of the bed casting. The graphitic carbon normally found in pearlitic iron is retained, providing a multitude of microscopic reservoirs for retention of lubricant on the ground way surfaces. Consequently, the film adheres longer and more tenaciously than would be possible on a hardened steel surface.

Many gears also are being advantageously flame-hardened at the Monarch plant. They range from 1 1/2 to 24 diametral pitch and up to a maximum of 34 inches in pitch diameter. The method proves approximately 35 per cent faster than manufacturing methods employing through hardening, since there is no distortion to require finish grinding. On gears requiring a hardened surface for wear resistance only, a 50 to 56 Rockwell C hardness rating is easily obtained on the face of the gear tooth, and there is no need for core treatment or for heating the entire gear.

Flame-hardening is applicable to almost any steel having 35 to 55 points of carbon. At the Monarch plant a medium-alloy nickel-molybdenum steel within this range is employed to keep distortion at a minimum. Gears are hardened by a single-tooth progressive hardening method, also commonly called the Gleason method, a process in which the flame is applied simultaneously to both sides of a single tooth.

Because of the characteristics of the alloy used, a direct quench is usually not necessary. By quenching through the mass of the part, the desired hardness is readily obtained. Soluble oil is directed continuously on the gear blank, Fig. 3, keeping it at a constant temperature. The type of hardness pattern desired depends largely on the requirements the gear must meet in service. With this method, virtually any hardness pattern can be obtained on the gear tooth, since it is possible to harden the entire tooth below its root, to put a heavy case on a tooth with the hardness not extending to the root, or to obtain a very light case.

Some gears receive prior conditioning (by hardening furnace treatment), to provide a core hardness of 28 to 32 Rockwell C. The toughening of the core adds greatly to the shock resistance of the finished gear.

The flame-hardening equipment used for this application is designed so that once a set-up has been made, the gear is simply put in position, the start button pressed, and the gas ignited. From that point on, the cycle is completely automatic. The automatic cycle continues a predetermined number of times before stopping, depending upon the number of teeth to be hardened.

The equipment used is a standard No. 1 Gleason surface hardener, modified in design to incorporate certain fixtures and accessories designed by Monarch engineers to permit automatic cycling for the particular operation being handled. The machine continues to index the gear after the flame has been turned off, in order to assure even quenching of all gear teeth, including the very last. Through the use of a holding and indexing fixture, especially developed by the company, the teeth of racks are also being hardened on this equipment. This operation, similar to that followed for gears, results in a flame-hardened case of 50 to 56 Rockwell C on the teeth. A prior heat-treatment was used to impart a core toughness with a hardness of 30 to 35 Rockwell C.

Clutch teeth, too, are being flame-hardened with consistent success. The process proves especially advantageous on large gears and clutches, where a hardened wear-resistant surface is needed and yet a tough back-up core is also highly desirable. To accomplish this dual objective, a "merry-go-round" type of fixture, also developed at this plant, is employed. Once the clutch is brought up to the proper heat, it can easily be swung through a small angle and into a soluble oil quench.

Still other flame-hardening applications in lathe manufacture include the hardening of serrations on tool-blocks and the hardening of cam surfaces, templet surfaces, shifter forks, etc.

* * *

First National Congress of Applied Mechanics Announced

The First National Congress of Applied Mechanics will be held next June at the Illinois Institute of Technology in Chicago. Plans have been made to hold national Congresses every four years. Papers to be presented at the Congress will cover original research in applied mechanics, which includes kinematics, dynamics, vibrations, waves, and mechanical properties of materials and failure; stress analysis; fluid mechanics; and thermodynamics. The Congress is under the sponsorship of nine professional societies and four universities. Further information can be obtained from Lloyd H. Donnell, Illinois Institute of Technology, Chicago 16, Ill.

Design of Worm-Gear Hobs

Last of a Series of Articles Describing Methods of Designing Various Types of Worm-Gear Hobs, Based on British Practice

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PREVIOUS installments in this series, which appeared in November and December, 1950, MACHINERY, dealt with design considerations. This article discusses contact conditions between mating worm and worm-gear combinations and methods of eliminating faulty contact. Design schedules for worm-gear hobs and a detailed numerical example are given.

After a worm-gear has been cut, it is necessary to check for satisfactory contact conditions between it and the mating worm. This check is carried out by painting the worm threads with prussian blue and gearing the pair together. The blue is transferred from the worm thread to those parts of the gear-tooth flanks with which it comes into contact, so that an examination of the markings on the gear-tooth flanks enables the contact conditions between the worm and the gear to be assessed.

As seen in Fig. 10, the pressure angle of the gear-tooth flanks is high at one end of a flank and low at the other end, the low-angle sides of opposing flanks being at opposite ends of the teeth. If the teeth have been cut accurately, the marking spreads right across the gear teeth on both flanks. Very often, however, in the case of a gear cut by a fly hob, and occasionally in the case of a gear cut by a full hob, the markings are restricted to the tips at the low-angle side on each flank. Such restricted marking is to be avoided, since it indicates the possible presence of excessively high tooth pressure intensities under load. This may lead to a breakdown of the oil film, causing overheating and failure of the tooth surfaces.

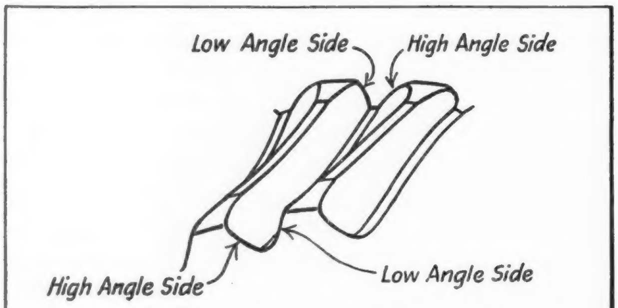


Fig. 10. Pressure-angle variation across gear-tooth flank

The reasons for this restricted marking are as follows:

(a) Contact between the hob and the gear starts farther from the pitch point on the low-angle side than it does on the high-angle side. This means that while the low-angle side of the tooth is being generated, the hob teeth are cutting on one side only, the other side being outside the zone of contact. This causes the hob teeth to be deflected, so that the flank of the gear tooth at this point is not cut so much as it should be, and consequently protrudes beyond its correct profile. This error does not occur to such an extent when both sides of the hob teeth are cutting, since the thrusts from the two sides tend to balance each other.

(b) The curvature of the gear-tooth profile is greater at the low-angle side than it is at any other point. As there are only a limited number of relative positions between the hob and the gear, the finished flank, instead of being a continuous curve, is in the form of a series of flats and salients. This effect is more pronounced on the low-angle side than at any other point, due to the greater curvature of the flank profile. These flats and salients are clearly visible at the tips of the low-angle sides of the teeth of a worm-gear before it has been run in.

(c) The effect of any error in generation of the worm and of the worm-gear is to reduce the amount of backlash between the pair when set at standard centers. To maintain the required backlash, the gears may be assembled at slightly extended centers, with the result that the marking is heavier on the low-angle side of each flank.

(d) Referring again to the fact mentioned under *(a)* that the thrust on the hob teeth is unbalanced when cutting on the low-angle side, it

follows that the backlash on the dividing gears is an additional reason why the low-angle sides of the teeth may have flanks which are higher than the correct profile. Thus, excessive backlash in the dividing gears is a further cause of restricted marking between worm and gear.

It is obviously preferable to avoid this restricted marking and contact by elimination of the causes rather than by attempting to correct the fault after it has occurred. This necessitates (1) the use of a very rugged hob; (2) the use of a full hob instead of a fly hob whenever possible; (3) reduction of the end backlash of the hob to a minimum; and (4) minimization of all running clearances and backlashes, particularly in the dividing gears. Careful attention should be given also to the design of the worm and the gear, since this has a considerable bearing on the type of contact between them. Thus, it is essential that low-pressure angles should be avoided, particularly in the case of worms of high lead angle, since such a combination results in an offset pressure angle at the low-angle side which approaches zero. This is a potent cause of restricted contact, since, the lower the pressure angle, the farther from the pitch point does contact take place on the low-angle side, so that there is a tendency for the trouble to be accentuated [see *(a)*].

In addition, low-pressure angles should be avoided due to the increased risk of under-cutting on the low-angle side. Occasionally an attempt is made to correct this tendency toward restricted contact by swinging the hob axis through a small angle. It is generally found, however, that, unless other hob tooth particulars are modified, this swinging results in a hollow marking on the gear teeth. In other words, contact occurs at both ends of each gear-tooth flank, but does not occur at the middle of the teeth. This is a fault nearly as serious as the fault that it is intended to correct.

In some cases, it is possible to correct the tendency to restricted contact by cutting the gear at extended centers and swinging the hob to provide compensation. Often, however, this leads to a hollow marking even if an over-size hob is employed.

Tooth Deflection under Load

If a worm and gear are set in their housing so that a full face marking is obtained at light loads, it is found that under full load the marking is restricted to the high-angle side of the worm-gear teeth. This is due mainly to the deflection of the shafts, bearings, and housings, but is also due, to a lesser extent, to deflection of the gear teeth and worm thread. If the gears are run under such conditions, the tooth pressure intensities are higher than those calculated, due to the restricted contact. Furthermore, in the usual case, where the worm drives the gear, this restricted area of contact is on the side of the gear where the worm enters into engagement, so that there is a tendency to cut off the supply of lubricant. This tends to cause overheating, with resultant failure before the teeth can become properly bedded in.

To overcome this tendency, the worm-gear should be set in the housing so as to give a light load marking on the low-angle side. When the drive is in one direction only, the gear can be offset from the central position to give a light load marking on the driving flank on the low-angle side. This results in the marking on the opposite flank being on the high-angle side, which is of no particular consequence if this flank does not have to transmit power. If, however, power has to be transmitted by this flank, deflection will tend to cause further load concentration on the high-angle side, thus making conditions even worse.

In the case where power has to be transmitted by both flanks, as in an automobile rear axle, where the over-drive loads are severe, the worm-gear teeth must be cut in such a manner that the light load markings are on the low-angle side of each flank when the gear is set centrally in its housing. The teeth of a worm-gear can be cut in this manner in one traverse of the hob by suitable modification of the hob details. Thus the pitch diameter of the hob should be slightly larger than that of the worm, and the lead slightly less than that of the worm, with appropriate modifications of the pitch, thread thickness, and pressure angle. In addition, the hob axis should be swung through a small angle, varying between about 0.1 and 1.5 degrees for normal hobs. The actual amounts of these modifications depend on the speed ratio, the worm and gear detail dimensions, and the deflection under load of the gears, shafts, bearings, and housings. Therefore, no hard and fast rule can be laid down for the solution of this difficulty.

From what has been said, the impression may be gained that the restricted low-angle contact, obtained inadvertently by using a fly hob, would be advantageous for such a gear. This is incorrect, however, as a fly-hob cut gear tooth tends to be inherently hollow, as can be shown by offsetting the gear, when the marking changes abruptly from the low-angle to the high-angle side. If the tooth has been correctly cut, offsetting the gear causes the marking to spread slowly across the gear-tooth face.

Design Schedules for Fly and Full Hobs

Design schedules suitable for a fly cutter or a full hob, based on British practices, may be arranged on the following lines.* As an illustration, figures have been added appropriate to the design of a cutter to generate a 39-tooth worm-gear mating with a four-start worm which has an involute helicoid thread of 20-degree normal pressure angle, 0.300-inch module (module = axial pitch of worm divided by π), and 3-inch pitch diameter.

Before commencing the design of the cutter, it is necessary to determine most of the dimensions of the worm, and some of the dimensions of the worm-gear, since these have a very important bearing on the detail dimensions of the hob.

In general, the designation of a worm is given in terms of t, q, and m, where

t = number of threads in the worm;
m = module, in inches;
q = worm diameter quotient;

$$= \frac{\text{pitch-circle diameter of worm}}{m}$$

$$= \frac{3.000}{0.300} = 10$$

Standard values of m and q should be taken from the accompanying table whenever possible. It is assumed that the general form of the worm is in accordance with British Standard Specification No. 721.

1. Designation of worm: $t = 4$; $q = 10$; and $m = 0.300$ inch
2. Pitch diameter of worm = pitch diameter of hob $= d = mq = 3.000$ inches
3. Lead of worm = Lead of hob $= L$ $= \pi\, tm = 3.770$ inches
4. Lead angle of thread of worm at pitch radius = lead angle of thread of hob at pitch radius $= \lambda_t$

$$\text{Tan } \lambda_t = \frac{L}{\pi \text{ (pitch diameter of worm)}}$$

$$\lambda_t = \tan^{-1}\left(\frac{\pi tm}{\pi mq}\right)$$

$$\lambda_t = \tan^{-1}\left(\frac{t}{q}\right) = 21 \text{ degrees } 48 \text{ minutes}$$

5. Addendum of worm $= a_p = m = 0.300$ inch
6. Dedendum of worm $= b_p =$ $m\,(2.2 \cos \lambda_t - 1) = 0.313$ inch

*See previous installments for derivations of formulas used.

Table of Standard Values for Module (m), in Inches, and Worm Diameter Quotient (q)

Range of m	Less than 0.1	0.1 to 0.2	0.2 to 0.5	0.5 to 0.8	Over 0.8
Increments of m.	0.001	0.005	0.01	0.02	0.05
Range of q.......	Less than 5	5 to 10	Over 10	....	....
Increments of q..	0.25	0.5	1.0	....	....

7. Addendum of worm-gear teeth $= A =$ $m\,(2 \cos \lambda_t - 1) = 0.257$ inch
8. Dedendum of worm-gear teeth $= B =$ $m\,(1 + 0.2 \cos \lambda_t) = 0.356$ inch
9. Clearance at bottom of teeth $= C =$ $(b_p - A) = (B - a_p) = 0.056$ inch
10. Axial pitch of worm = axial pitch of hob $= \pi m = 0.9425$ inch
11. Normal pressure angle $= \psi_n = 20$ degrees 0 minutes
12. Base cylinder diameter of worm = base cylinder diameter of hob, as given by Equation (1) $= d_o$

$$= d \cos\left[\tan^{-1}\left(\frac{\tan \psi_n}{\sin \lambda_t}\right)\right] = 2.143 \text{ inches}$$

13. Lead angle of worm thread at base cylinder radius, as given by Equation (2) = lead angle of hob thread at base cylinder radius = tool setting angle to generate thread of worm or hob $= \lambda_o$

$$= \tan^{-1}\left(\frac{L}{\pi d_o}\right) = 29 \text{ degrees } 15 \text{ minutes}$$

14. Worm face length $= F_p$, and as a general rule,

$$F_p = m\sqrt{3(2T - 1)} = 4.56 \text{ inches}$$

$$= 4\ 3/4 \text{ inches, say, since } T = 39$$

15. Caliper settings

The axial thread thickness is made equal to half the axial pitch at the mean depth of the thread (where the thread depth includes the clearance). "Constant chord" caliper settings are calculated for this mean depth position, and are derived in a manner somewhat similar to those for spur gears. In the case of spur gears, however, there is a basic rack, and all gears meshing with this rack have constant chord settings, irrespective of the number of teeth in the gear. Constant chord settings are used with worm-gears since they are the only settings precisely calculable when working to an axial thread

thickness of half the axial pitch at the mean thread depth. Then

Thread diameter at mean depth

$$= d_c = \frac{3.600 + 2.374}{2} = 2.987 \text{ inches}$$

Lead angle at mean depth

$$= \lambda_c = \tan^{-1}\left(\frac{tm}{d_c}\right)$$

$$= \tan^{-1}\left(\frac{4 \times 0.3}{2.987}\right)$$

$$= 21 \text{ degrees } 53 \text{ minutes}$$

Normal pressure angle at mean depth

$$= \psi_{nc} = \cos^{-1} (\cos \lambda_o \sec \lambda_c)$$

$$= 19 \text{ degrees } 54 \text{ minutes}$$

Thickness setting

$$= g_{cc} = 1/2\ \pi m \cos^2 \lambda_o \sec \lambda_c = 0.387 \text{ inch}$$

Height setting

$$= h_{cc} = 1/2\ (a_p + b_p) - 1/2\ g_{cc} \tan \psi_{nc} = 0.236 \text{ inch}$$

16. Backlash allowance $= 0.012$ inch
17. Addendum of hob teeth, as given by Equation (9) $= a_h = a_p + c = 0.356$ inch
18. Dedendum of hob teeth, as given by Equation (10) $= b_h = b_p - c = 0.257$ inch

For Fly Hob Only

19. Outside diameter of hob $= d + 2a_h = 3.712$ inches
20. Root diameter of hob $= d - 2b_h = 2.486$ inches
21. Diameter of bar from which fly tooth is made $= (a_h + b_h)$ approximately $= 0.613$ inch $= 5/8$ inch, say
22. Diameter of arbor $= d - 2b_h -$ a clearance* $= 2.486 - 0.300 = 2\ 1/8$ inches, say
23. Lead of relieved leading edge, as given by Equation (5) $= L_l = \pi d \tan (\lambda_t + \beta) = 4.360$ inches, assuming that $\beta = 3$ degrees
24. Lead of relieved trailing edge, as given by Equation (6) $= L_t = \pi d \tan (\lambda_t - \beta) = 3.210$ inches
25. Caliper settings at cutting edge
    Thickness = worm thread thickness + backlash = 0.399 inch
    Height = worm thread height + c = 0.292 inch

*This clearance is normally made equal to m, the module of the worm.

†This assumes that the wear allowance, on radius, is approximately equal to $\left(\frac{r}{6}\right)$.

For Full Hob Only, of the Straight Type

19. Outside diameter of hob, without allowance for wear $= d + 2a_h = 3.712$ inches
20. Root diameter of hob $= d - 2b_h = 2.486$ inches
21. Number of flutes $= f$ (as given by Equation (11)

$$= \left(\frac{2d \cos \lambda_t}{a_h + b_h}\right) = 9, \text{ say}$$

22. Depth of flutes $= 1.2\ (a_h + b_h) = 0.736$ inch
23. Relieving cam rise, as given by Equation (12) $= r$

$$= 1.6\ (a_h + b_h)\left(\frac{d + 2a_h}{d}\right) \tan \beta_t = 0.170 \text{ inch}$$

assuming that $\beta_t = 8$ degrees

24. Number of reciprocations of relieving tool per revolution, as given by Equation (8) $= k = f \sec^2 \lambda_t = 10.440$

The actual value of k, using the nearest available change-gears $= \frac{240}{23} = 10.435$

25. Corrected lead angle of flutes, allowing for actual value of k, as given by a modified form of Equation (7) $= \lambda_f$

$$= \tan^{-1}\left(\frac{f \tan \lambda_t}{k - f}\right) = 68 \text{ degrees } 16 \text{ minutes}$$

26. Actual lead of flutes $= L_f = \pi d \tan \lambda_f = 23.642$ inches
27. Hob face length $= F_p + \frac{L}{f} = 5.169$ inches $= 5\ 1/4$ inches, say
28. Caliper settings

This straight hob, if of the roughing type, will be followed by a finishing hob. As a consequence, the threads are made thinner than those of the finishing hob by an amount equal to $0.010 \times$ axial pitch, that is, by an amount equal to 0.009 inch.

Thickness $= 0.387 + 0.012 - 0.009 = 0.390$ inch

Height $= 0.236 + 0.056 = 0.292$ inch

29. Caliper settings for finishing hob
    Thickness $= 0.387 + 0.012 = 0.399$ in.
    Height $= 0.236 + 0.056 = 0.292$ inch.
30. Outer diameter of roughing hob, assuming that allowance for wear is made on the teeth,

$$= \left(d + 2a_h + \frac{2r}{6}\right)^{\dagger} = 3.768 \text{ inches}$$

31. Pitch diameter of roughing hob, with wear allowance added, when new

$$= \left(d + 2 \frac{r}{6} \right) = 3.056 \text{ inches}$$

32. Lead angle of hob thread, at new pitch diameter, for roughing hob with wear allowance

$$= \tan^{-1} \left(\frac{L}{\pi \text{ pitch diameter when new}} \right)$$

$= 21$ degrees 26 minutes

33. Angle at which roughing hob should be set over to cut gear correctly when hob is new
$=$ difference in lead angle for hob when new and when at standard diameter
$= 0$ degree 22 minutes

* * *

Where to Obtain Information Concerning the National Production Authority

The United States Department of Commerce has announced that the field offices of that department are in a position to supply information concerning the National Production Authority. Field offices are located across the country in the following cities:

Albuquerque, N. Mex., Hanosh Bldg., 203 W. Gold Ave.
Atlanta 3, Ga., 418 Atlanta National Bldg., 50 Whitehall St., S. W.
Baltimore 2, Md., 314 U. S. Appraiser's Stores Bldg., 103 S. Gay St.
Birmingham, Ala., 319 Frank Nelson Bldg., Second Ave. and 20th St.
Boston 9, Mass., 1800 Custom House.
Buffalo 3, N. Y., 242 Federal Bldg., 117 Ellicott St.
Butte, Mont., 301A O'Rourke Estate Bldg., 14 W. Granite St.
Charleston 3, S. C., 310 Peoples Bldg., 18 Broad St.
Cheyenne, Wyo., 206 Federal Office Bldg., 21st St. and Carey Ave.
Chicago 4, Ill., 1150 McCormick Bldg., 332 S. Michigan Ave.
Cincinnati 2, Ohio, 1204 Federal Reserve Bank Bldg., 105 W. Fourth St.
Cleveland 14, Ohio, Union Commerce Bldg., 925 Euclid Ave.
Columbia, S. C., Area 2-H Cornell Arms Bldg., Sumter and Pendleton Sts.
Columbus, Ohio, Trautman Bldg., 209 S. High St.
Dallas 2, Tex., Room 1114, 1114 Commerce St.
Denver, Colo., 142 New Custom House.
Des Moines 9, Iowa, 601 Securities Bldg., 418 Seventh St.
Detroit 26, Mich., New Federal Bldg., 230 W. Fort St.
El Paso, Tex., Chamber of Commerce Bldg., 310 San Francisco St.
Fargo, N. Dak., 207 Walker Bldg., 621 First Ave., N.
Hartford 1, Conn., Post Office Bldg., 135 High St.
Houston 14, Tex., 602 Federal Office Bldg.
Jackson, Miss., Room 203, 301 N. President St.
Jacksonville 1, Fla., 425 Federal Bldg., 311 W. Monroe St.
Kansas City 6, Mo., Fidelity Bldg., 911 Walnut St.
Los Angeles 12, Calif., 1546 U. S. Post Office and Court House, 312 N. Spring St.
Louisville 2, Ky., 631 Federal Bldg.
Manchester, N. H., Beacon Bldg., 814 Elm St.
Memphis 3, Tenn., 229 Federal Bldg.
Miami 32, Fla., 947 Seybold Bldg., 36 N. E. First St.
Milwaukee 2, Wis., 700 Federal Bldg., 517 E. Wisconsin Ave.
Minneapolis 1, Minn., 338 Midland Bank Bldg., 401 Second Ave., S.
Mobile 10, Ala., Federal Bldg., 109-13 St. Joseph St.
Newark, N. J., 325 Industrial Bldg., 1060 Broad St.
New Orleans 12, La., 1508 Masonic Temple Bldg., 333 St. Charles Ave.
New York 4, N. Y., 42 Broadway.
Oklahoma City 2, Okla., 311 Council Bldg., 102 N. W. Third St.
Omaha 2, Nebr., 502 W.O.W. Bldg., 1319 Farnam St.
Philadelphia 6, Pa., Lafayette Bldg., 437 Chestnut St.
Phoenix, Ariz., 518 Security Bldg., 234 N. Central Ave.
Pittsburgh 19, Pa., 1013 New Federal Bldg., 700 Grant St.
Portland 4, Oreg., 217 Old U. S. Court House, 520 S. W. Morrison St.
Providence 3, R. I., 203 Custom House, 24 Weybossett St.
Reno, Nev., Cladianos Bldg., 113 W. Second St.
Richmond 19, Va., Room 2, Mezzanine, 801 E. Broad St.
Rochester, N. Y., 819 Commerce Bldg., 119 E. Main St.
St. Louis 1, Mo., 910 New Federal Bldg., 1114 Market St.
Salt Lake City 1, Utah, 508 Post Office Bldg., 350 S. Main St.
San Antonio, Tex., Bedell Bldg., 118 Broadway.
San Diego, Calif., U. S. Custom House, 325 W. F St.
San Francisco 11, Calif., 306 Custom House, 555 Battery St.
Savannah, Ga., 218 U. S. Court House and Post Office Bldg., 125-29 Bull St.
Seattle 4, Wash., Federal Office Bldg., 909 First Ave.
Spokane, Wash., 401 Columbia Bldg., 107 Howard St.
Syracuse, N. Y., 918 Chimes Bldg., W. Onondaga and S. Salina St.
Tampa, Fla., 307 Wallace Bldg., Annex, 608 Tampa St.
Trenton, N. J., Old Post Office Bldg., Room 306, E. State and Montgomery Sts.
Wilmington, Del., Front and French Sts.
Worcester, Mass., Room 201, Dean Bldg., 107 Front St.

* * *

Accurate Shearing of Galvanized Sheet Moving at 200 Feet Per Minute

Shearing of strip material moving at various speeds up to 200 feet per minute with such precision that each piece is within 1/8 inch of the same length is a problem in mills producing galvanized sheet for roofs. The old method had been to use a continuously rotating cutter, so geared as to make one cut each revolution. But this was an expensive device, and involved a gear change each time a different length of cut was desired.

Now an electronically controlled cutter developed by Westinghouse Electric Corporation is used. A photo-tube is set on the far end of the table a certain exact distance short of the length of galvanized sheet desired. When the end of the sheet arrives at that point, the photo-tube gives the signal to the cutter motor unit, which starts, makes the cut, and stops in precisely the original position waiting for the next cutting signal. This shear can be varied to make accurate cuts of different lengths and for different production speeds from 30 to 200 feet per minute.

Business Mobilization Dinner Held by Society of Business Magazine Editors

PRESIDENT Truman was the principal guest of honor at a dinner given by the Society of Business Magazine Editors for the purpose of promoting closer contact between the editors of business magazines and the government officials who are planning the mobilization of industry in support of our National Defense program. Among the more than forty guests of honor were Cabinet members, outstanding business leaders, Senators, Congressmen, and heads of various Government bureaus. The dinner was held in the Presidential Ballroom of the Hotel Statler at Washington, D. C., on January 19.

The President outlined the problems of the Government in the huge task of industry mobilization. He was followed by General William H. Harrison, Director of National Production Authority, who made a major address in which he stressed the magnitude of the job that confronts industry and explained the plans that are being developed to expedite production.

Paul Wooton, executive secretary of the S.B.M.E., was presented by President Truman with the Silver Quill of the National Business Publications in recognition of the work he has done in promoting closer contact and better understanding between officials of the Government and editors of business magazines. Mr. Wooton then gave a short talk in which he offered the resources of business papers in facilitating rearmament operations. He pointed out that during World War II considerable time and money were spent in determining the best methods of performing the innumerable manufacturing jobs connected with war production, and stressed the fact that much of the practice followed during the war years is still applicable.

Detailed information concerning those practices can be made available by magazines. As an indication of the great amount of such information on hand, Mr. Wooton cited the case of one magazine in the metal-working field that published about 325 articles totaling 2000 pages, on the manufacture of war materiel during the war period. He also called attention to the fact that business papers can publicize manufacturing operations and techniques that have been especially productive, so that they can be applied in other manufacturing plants to best advantage. He mentioned that one of the business magazines inserted in regular issues pamphlets brought out by the Ordnance Division of the Army in 1942 and 1943 which described numerous time-saving practices.

A third point stressed by Mr. Wooton was that magazines could assist the Government in quickly finding men qualified by knowledge and experience to fill highly specialized positions. For example, a business paper editor who had visited the most important metal-working plants in Germany was assigned to the War Department by his own magazine to assist in planning the pin-point bombing which crippled German industry.

At the end of the speeches, the Society adopted the following Resolution:

Whereas it is now clear that we who believe in the freedom of mankind are involved in a great world struggle with those who do not, and

Whereas this struggle may be the last opportunity to prove that free labor led by free management can produce more than slave labor under dictators

Therefore, be it resolved that:

We who enjoy individual freedom as independent editors of America's business magazines do hereby pledge ourselves as editors to arouse and support the kind of productive effort that will demonstrate the omnipotent power of the free spirit.

And be it further resolved that:

A copy of this resolution be delivered to the President of the United States, to the Director of Mobilization, and to the Administrator of the National Production Authority.

A luncheon meeting of the Society was held on the same day, at which the speakers were John D. Small, chairman of the Munitions Board; Cyrus Ching, chairman of the Stabilization Board; and Michael DiSalle, chairman, Price Stabilization.

* * *

Cutting Tool Manufacturers Association Elects New Officers

At its annual meeting in December, the Cutting Tool Manufacturers Association re-elected Emil Gairing, of the Gairing Tool Co., president. Walter Fuller, of the Fuller Tool Co., was elected vice-president, and R. S. Spencer, of the Detroit Boring Bar Co., was re-elected treasurer.

Materials of Industry

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Easily Applied Protective Coating for Aluminum Parts

Aluminum can be prepared for painting or protected from corrosion by the application of a new coating material announced by the Chemclean Products Corporation, New York City. This material, called "Protecto-Cote," is supplied already mixed, and needs only to be dissolved in water in the proportion of 6 ounces to one gallon of water.

The work to be finished is immersed for about five minutes in the solution, which is kept at a temperature of 185 degrees F. No electric current is required, the equipment consisting merely of steel tanks with facilities for heating. The solution is self-cleaning, making the process a one-operation job. The process is applicable to machine parts as well as decorative products, since no dimensional changes take place.......1

Sealing Liquid that Hardens when Kept Away from Air

A plastic material that remains liquid as long as a stream of air passes through it, but that solidifies in a few minutes when kept away from air, has been developed by the Chemistry Division of the General Electric Research Laboratory. Its properties are the opposite of those of paint, which hardens when exposed to air. The new compound undergoes a chemical change, called polymerization, and hardens fully without the necessity of any evaporation taking place.

This material, "Anaerobic Permafil," is able to penetrate extremely small cracks before hardening, a fact that indicates its possible use as a seal for nearly invisible leaks. Certain metals, such as copper, iron, and silver solder, exert an accelerating action on the hardening process, even at room temperature. Such metals can be sealed more quickly than glass and mica surfaces which are inert, though they, too, can be tightly fastened. Paper and fabric also can be bonded to themselves and to other materials.

One proposed use of the compound would eliminate the lock-nut needed to hold another nut tightly on a bolt. A few drops may be placed on the threads of the bolt just before the nut is screwed on. The plastic will harden so much that considerable force is required to remove the nut.

When applied to threaded joints in pipes, the liquid penetrates into the crevices and then hardens, effectively preventing leaking. It can also be painted on porous castings to render them airtight.

This sealing compound is not yet available commercially, although plans are being made to put it on the market.......................2

Two New Liquid Tripoli Polishing Compounds

Two polishing compounds have been added to the line of liquid tripoli compositions made by the Hanson-Van Winkle-Munning Co., Matawan, N. J. These compositions are oil-water emulsions, and have excellent cutting qualities, combined with high coloring ability for the degree of cut obtained. One of the new compounds—Acme 2-L-177—is recommended for maximum cut, while the other—2-L-178—is for cut-color on such materials as brass, die-castings, aluminum, or wherever general-purpose tripoli compositions would be used. 3

Flat Leather Belting with an "Anti-Stretch" Rayon-Cord Insert

Flat leather belting incorporating a rayon tire cord insert to assure stretch resistance is being produced by the Charles A. Schieren Co. of New York City. The new product, called Schieren Duxbak Rayon-Core belting, consists of a layer of rayon tire cords cemented between two layers of Duxbak leather belting. An extremely low stretch characteristic in service is claimed for the belt, and some users have reported six months to a year of operation without any take-up. 4

To obtain additional information about materials described here, use Inquiry Card on page 227.

Coating that Reduces Glare of Guided Missiles

A plastic synthetic finish, VB 248, that was developed to dull the reflecting surfaces of stainless steel in guided missiles, aircraft instruments, and other apparatus, has been announced by the United Lacquer Mfg. Corporation, Linden, N. J.

The new finish provides a coating that will adhere to the highly polished stainless steel used in various aircraft devices and eliminate light reflection and glare. Though originally made in black and in a dull finish to eliminate glare, it is expected to find other applications, in which case, it may be prepared in all colors, in a semi-gloss or gloss finish. 5

Neoprene Rubber Compound for Universal Joint Covers

Production of a molded rubber cover designed for use as a grease retainer on aircraft universal joints has been announced by the Stalwart Rubber Co., Bedford, Ohio. Stalwart No. 808 Neoprene-based rubber compound — the material used in this application—can withstand concentrations as great as 0.003 per cent of ozone for a six-hour period and temperatures as low as —87 degrees F. or as high as 240 degrees F. It is also resistant to petroleum products and their derivatives. Other properties include a tensile strength of 2315 pounds per square inch, a durometer hardness of 60, elongation of 400 per cent, and a permanent set of 3 per cent. 6

Phenolic Laminate with Uniform Strength in All Directions

The Richardson Co., Melrose Park, Ill., has brought out a reinforced phenolic laminate for mechanical applications requiring uniform strength throughout, such as non-metallic gears, cams, pinions, textile bobbin heads, and many other parts. The new laminate, designated "Insurok Grade T-815," is reinforced by unwoven cotton fibers, laid at random in a mat arrangement. This structure results in uniformity of strength (tensile, impact, and flexural) in the main direction, cross direction, and at all intermediate angles throughout the planes of the material. The physical characteristics of this material are rated as better than high-strength woven-cotton fabric-base materials.

Machinability is excellent, and machined surfaces have a good finish. The new plastic can be punched, shaped, turned, milled, drilled, or threaded, and intricate machined shapes, such as fine-pitch gears and threads, are easily produced. It also has good electrical and moisture-resistant properties, and is available in a complete range of sheet sizes and thicknesses. 7

Flux for Soldering Aluminum to Copper, Steel, and Bronze

Aluminum solder flux that can be reactivated after drying out by simply adding water is a new product of the All-State Welding Alloys Co., Inc., White Plains, N. Y. "No. 39 Brazaloy Flux," as it is called, can be used with aluminum solder rods of any commercial brand, and can be employed with an open flame and under certain conditions, with a soldering iron. This flux is applicable for soldering aluminum to other metals such as copper, steel, bronze, etc. 8

New Silicone Rubber Permits Easier Molding

A new silicone-rubber compound developed by the Chemical Department of the General Electric Co., Pittsfield, Mass., permits easier molding of silicone-rubber parts and provides highly improved mechanical and thermal properties. Many mechanical parts can be fabricated from this compound designated 81223—without prolonged oven cure, and it has excellent molding and extrusion properties after only a five-minute warm-up. Because of its outstanding hot tear strength, parts with under-cuts can easily be removed from molds; and being neutral in color, stock can be colored for product identification purposes. Many new applications for silicone-rubber, such as diaphragms, belting, hose, and mountings, are anticipated as a result of the improved molding characteristics and properties of the new compound. 9

Isolating Paste for Selective Hardening of Steel

The Denfis Chemical Laboratories, Inc., Brooklyn, N. Y., has announced an improved Isopac isolating paste, characterized by greater stability. This product is used to prevent hardening of certain sections of work-pieces which are being casehardened. It is a heavy paste that is applied before starting the hardening operation, and works by preventing the rapid cooling of the protected areas during the quenching of the work-piece. The paste can be used to replace copper-plating, machining, or other methods of protecting certain areas against hardening, and will not crack or shrink while in use. 10

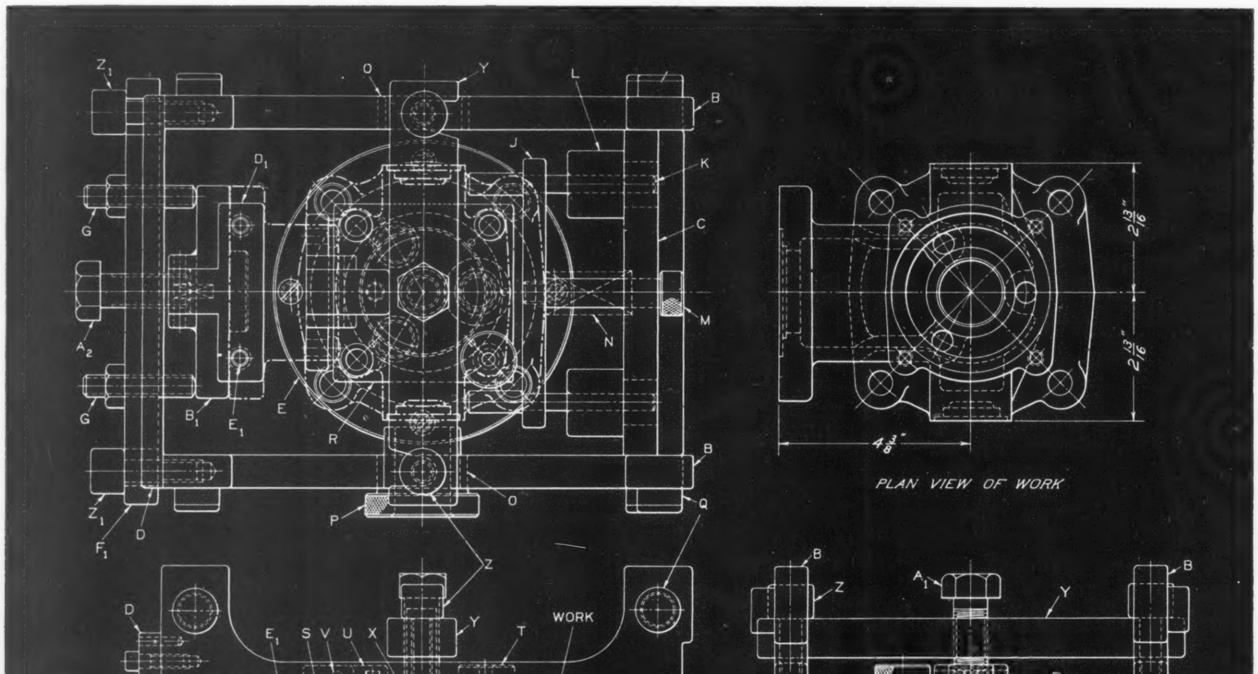
Tool Engineering Ideas

Tools and Fixtures of Unusual Design, and Time- and Labor-Saving Methods that Have been Found Useful by Men Engaged in Tool Design and Shop Work

Drill Jig with Equalizers Designed to Handle an Irregular Casting

By ROBERT W. NEWTON, Assistant Chief Tool Designer
New York Air Brake Co., Watertown, N. Y.

Two types of equalizers are used on the drill jig shown in the accompanying illustration that have been used many times with good results. The work-piece handled in this jig is a cast-iron upper housing for an air brake control valve. The coring required in this part, together with the neck-shaped outside contour, the three flanges, and the side bosses, makes it a difficult piece to cast, with the result that there is bound to be some shifting when it is placed in a jig for drilling. It was therefore necessary to design a drill jig so that each flange could be drilled independently of the others. At the same time, the drill jig plate used for each flange had to be square



Drill jig that utilizes equalizers for producing holes in a cast-iron part

with an outside edge, so that the bolt-holes would be drilled as straight as possible relative to the housing body.

The tapped holes, one in the middle of each side boss, were so close to the large counterbores that provision could not be made for tap-drilling them with the jig illustrated. Hence, a small drill plate was used for this purpose, independently of the large jig. This plate was located from the two large counterbores in the casting.

The main framework of the jig consists of a baseplate A and two plates B that act as legs when drilling the top and bottom holes in the work-piece. These legs are braced on the sides by straps C and D. A hardened plug E is fitted into a counterbore in the baseplate and fastened with screws. The work-piece is located by the boss on its base fitting into a counterbore in this plug.

In baseplate A are four bushings F for use in drilling bolt-holes in the work, and there are three liner bushings for a slip bushing H, which is used in drilling three holes that are later to be reamed. The work-piece is squared by means of an equalizer working from the stiffener plate C and acting against the two side bosses of the casting.

The equalizer consists of a plate J into which two pins K are driven. One end of each of these pins is rounded and rests against the work. The other end slides in bushings L, pressed into the stiffener plate to provide a longer bearing surface for the pins. These pins are located so that they contact the work as near the ends of the bosses as practical.

A knurled-head screw M is fastened to plate J and slides in plate C. To load the jig, screw M is pulled back, compressing spring N. When the work is in position, the screw is released and the spring provides pressure against plate J, which forces the work around until it is against both pins K.

In each of the two side plates B are two liner bushings O, which are large enough in diameter to permit entry of a counterbore. A slip bushing P, used in these liner bushings, guides the drill for a smaller hole. Together, the liners and slip bushings O and P permit the drilling of four large side holes and counterbores. During these operations, the jig is supported on four pins Q, which act as legs in each side of plate B.

A boss on the top bushing plate R is located in a bored hole in the work-piece. In this plate, are four liner bushings S and a slip bushing T for use in tap-drilling four holes in the top flange of the part. This plate is squared with the edge of the top flange on the work-piece by means of an equalizer U that slides between two blocks welded to plate R and pivots on a pin V driven through them. Two round-ended pins W, driven into equalizer U, contact the work as near the ends of the flange as practical. A spring X, nested in plates R and U, provides pressure against the work-piece.

After the top bushing plate R is properly located, a swing clamp Y (open at both ends) is placed in position under two screws Z that are in the side plates. A screw A_1, in threaded engagement with the swing clamp, is in contact with the bushing plate R. This screw is turned to raise the swing clamp until contact is made with the under side of the screw heads Z, thereby securely clamping the bushing plate and the work.

The bushing plate and equalizer for producing four bolt-holes in the side flange of the casting are of essentially the same design. A boss on the side bushing plate B_1 is located in a bored hole in the side flange of the work-piece. Four bushings C_1 are used for this operation, and the plate is squared with an edge of the side flange by an equalizer plate D_1. This plate slides between two blocks welded to plate B_1 and pivots on a pin V_1 driven through them. Two round-ended pins E_1, pressed into plate D_1, contact the work as near the ends of the flange as is practical. A spring X_1, nested in plates B_1 and D_1, provides pressure against the work-piece.

After the side bushing plate B_1 is properly located, a swing clamp F_1 (open at both ends) is placed in position under two screws Z_1 that are in the side plates. Then screw A_2 is turned to force the clamp against the heads of screws Z_1 until plate B_1 is securely clamped against the work. Two socket-head set-screws G in the swing clamp F_1 are fitted with lock-nuts, and can be adjusted to insure that plate B_1 is clamped squarely against the face of the side flange in the work-piece.

If the quantity of holes to be drilled is taken into consideration, this jig is not too difficult or expensive to make. When it replaced the box type leaf jig originally used, most of the rejections caused by the poor appearance of the drilled holes in relation to the flange contours were eliminated.

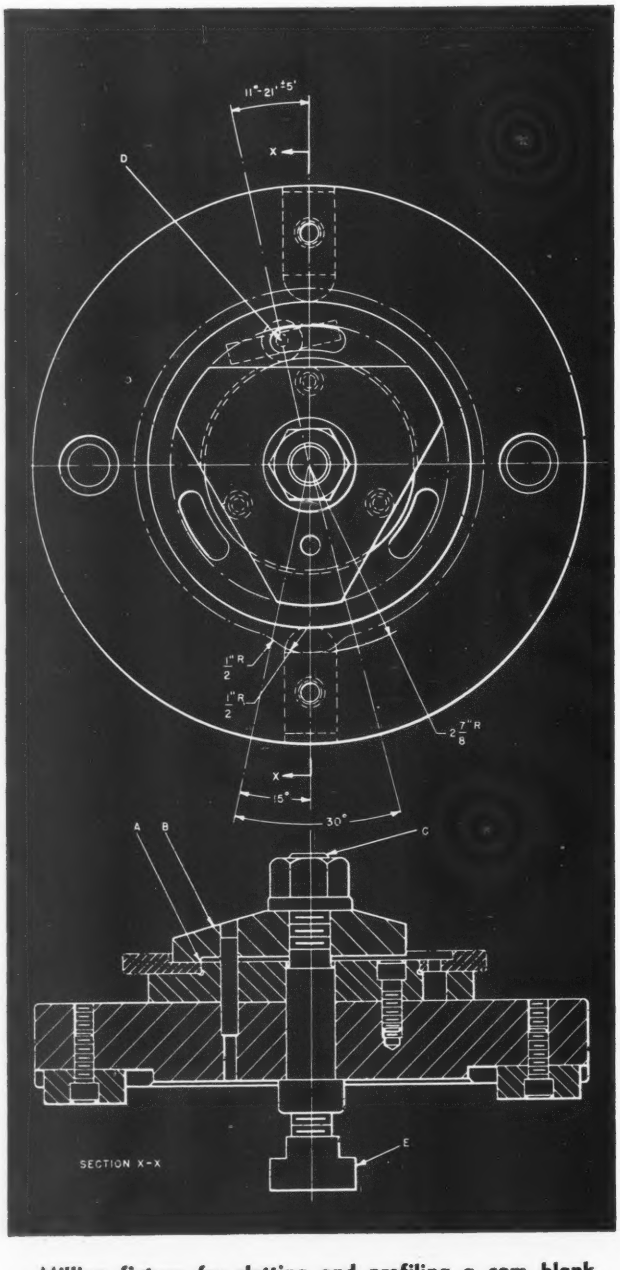
Simple Milling Fixture for Profiling and Slotting Cam Blanks

By ROBERT MAWSON, Providence. R. I.

In order to prove efficient as a manufacturing tool, a milling fixture must locate a work-piece accurately, hold it securely, and provide for

positioning the tool relative to the machine table. A milling fixture with all of these features is shown in the accompanying illustration. It is used for milling three equally spaced, curved, elongated holes in a machine-steel cam blank and for milling the periphery of the blank to the contour indicated by the dot-and-dash lines.

Prior to the milling operation, the cam blank is bored, recessed, faced, and turned. The work is positioned in the fixture by the machined bore, which fits over a projecting locating member *A*. A triangular machine-steel clamp *B* contacts the cam on a recessed surface. The clamp is bored to provide a slide fit for the vertical bolt *C*, the threaded end of which passes through the clamp



Milling fixture for slotting and profiling a cam blank that provides a simple means of maintaining the relationship between the three elongated slots and the cam lobe

to engage a nut. Clamping pressure is obtained by tightening the nut.

Three curved, elongated slots are machined in clamp *B* to provide clearance for a 13/64-inch diameter end-mill. A 3/16-inch diameter hole *D*, located in alignment with the center of one of these slots and at an angle of 11 degrees 21 minutes from the vertical center line, is used for aligning the elongated holes with reference to the cam lobe by means of a hardened and ground locating pin after the slots are milled. The locating pin (not shown) has two diameters, one having a slide fit in the machined slots in the work, and the other a slide fit in hole *D*. A handle is provided with this pin to facilitate locating it in the work and hole *D*.

In operation, the fixture is fastened to the rotary table of a vertical milling machine by means of T-head bolts *E* which engage slots in the table. With a 13/64-inch diameter end-mill in the spindle of the machine, the fixture is rotated until the end-mill is aligned with hole *D*. A cam blank is then positioned over the locating disk *A*, after which clamp *B* is tightened.

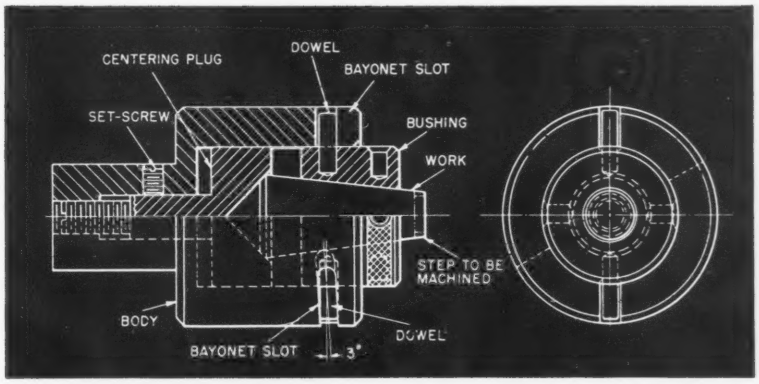
With the work located in this position, the table is rotated 22 degrees, 42 minutes to complete the first slot, after which the tool is removed and the table positioned for the second slot. The machining of the second slot is accomplished in the same manner, and the process repeated for the third slot.

After completing the third slot, the locating pin is inserted through it, into hole *D* to maintain the correct relationship between the slots and the cam surface which is to be milled on the periphery of the blank. A 1-inch diameter end-mill is used for machining this surface, the table being turned to within 15 degrees of each side of the vertical center line to produce the lobe. The 1/2-inch radii are formed by backing the table away from the cutter in the usual manner.

Quick-Acting Chuck for Tapered Parts

By W. M. HALLIDAY, Birkdale, Southport, England

The quick-acting chuck illustrated on the opposite page was designed for holding tapered parts. The work-piece shown required a secondary machining operation to produce the step in the small-diameter end. This step was omitted through oversight in the original machining operation. The over-all length of the part had to be maintained within close tolerances, and the end surfaces were required to be as flat as possible and square with the longitudinal axis of the part. Because of the application of the part, the



Quick-acting chuck that exerts a powerful and positive locking action on tapered parts with a minimum of effort. Precision tolerances are maintained, due to the fact that consistent end-wise location is insured

end surfaces could not be center-drilled for mounting between centers in the usual way.

The body of the chuck is machined at one end to form a parallel or tapered shank, which allows the chuck to be gripped in the collet of the lathe. A centering plug is screwed into the shank end of the body. This plug has a conical recess machined in the face on the flanged end to suit the chamfer previously produced on the work. The conical recessed surface of the plug should be hardened and ground to minimize wear and insure accuracy in centering the tapered part.

A small screwdriver slot is machined across the left-hand end of the centering plug to facilitate adjusting the plug within the body. The plug can be locked in any desired position by means of a brass set-screw that bears on the unthreaded portion of the plug shank.

The hardened brass locating bushing is a snug sliding fit in the large bore at the front of the chuck body, and is taper-bored to fit the work-piece. Two hardened steel dowel-pins, driven into diametrically opposite holes in the bushing, project radially outward through a pair of bayonet slots machined in opposite sides of the body. The bayonet slots are made about 1/64 inch wider than the diameter of the dowel-pins, and are inclined around the periphery of the body at an angle of 3 degrees.

Entrances to each slot extend out through the end of the body, and are chamfered to allow the dowel-pins to enter readily. The portion of the bushing that normally projects from the end of the body is knurled to facilitate gripping by hand, and is also provided with three or four radial holes to permit the use of a spanner wrench or drill rod when loading or removing the bushing.

In operation, the tapered work-piece is inserted into the bore of the bushing, and the loaded bushing is slid into the body of the chuck. When the dowel-pins engage the bayonet slot, the bushing is rotated by hand. The inclination of the slots will cause the bushing to be drawn gradually into the body.

When the chamfer on the work contacts the conical recess in the plug, the work-piece will automatically and accurately become centralized with the chuck body. By then applying a spanner wrench to the bushing, sufficient pressure can be exerted to hold the work securely during machining. Overhang of the part beyond the end of the chuck can be varied by loosening the set-screw and adjusting the centering plug with a screwdriver.

With this simple, low-cost chuck, a powerful and positive locking action is obtained quickly by a minimum of effort. Precision tolerances can be maintained, and the finish previously applied to the tapered surfaces of the parts is not damaged. Each part inserted into the chuck will occupy the same endwise position, regardless of variations in the over-all length of the parts. As a result, once the cutting tool has been set up, each part may be faced to exactly the same length.

By providing a number of locating bushings, each having a different size tapered bore, one chuck can be used for many different parts. The shape of the bore can be varied to handle parts other than conical. Also, the inclination angle of the bayonet slots can be changed to alter the amount of locking movement and the pressure applied on the work.

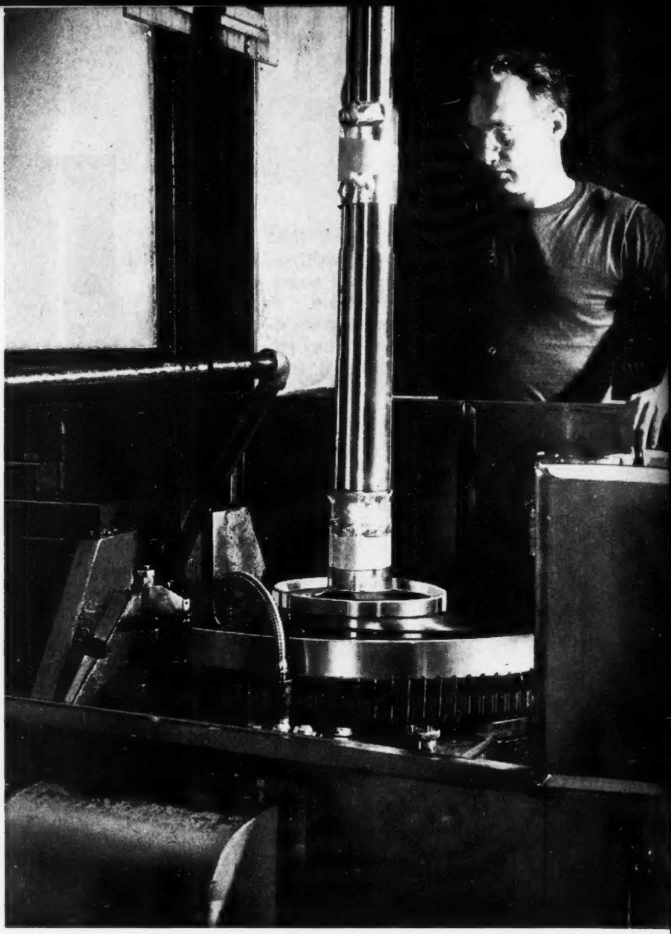
* * *

Automatic Lubricating System for Machine Tools

A system of constant and automatic delivery of lubricating oil to all types of machine bearings in "air-borne" microscopic particles through tubing has been developed by the Alemite Division of Stewart-Warner Corporation, Chicago, Ill. This system, known as "Oil Mist," is said to virtually eliminate the human factor in lubrication, economize in lubricant consumption, and prolong bearing life. Also, reduction of bearing temperatures permits higher machine speeds.

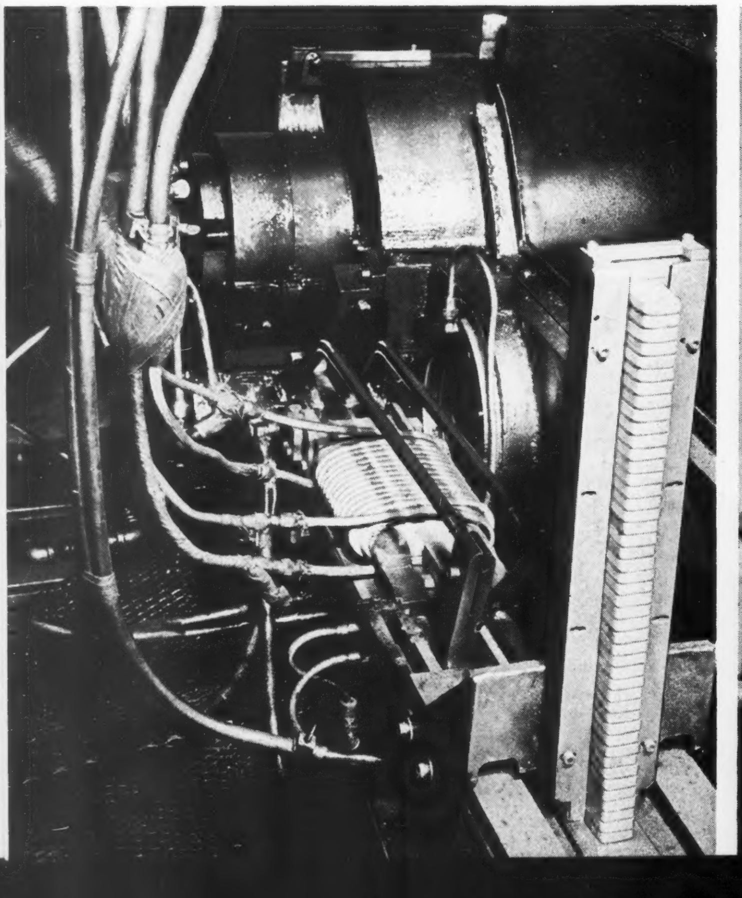
Operations in Building General Electric New Turbo-Jets

"ALL-WEATHER" axial-flow jet engines are now in volume production to meet defense needs at the Lynn and Everett, Mass., plants of the General Electric Co. These engines are equipped to eliminate icing-up and have special ignition systems for high-altitude starting, as well as other newly developed features. Typical operations employed in building these new "power plants" are illustrated here.



Turbine disks have each "pine tree" and its basic slot broached in a single pass in about one-eighth of the time required when the "pine trees" and slots were broached separately

Small turbine blades are forged from T-shaped flat blanks by a National "Reduceroll" fed automatically from magazine and induction heated



Grinding "pine tree" form on dovetail of turbine buckets is performed on a special Jones & Lamson automatic vertical form-grinding machine

Accessory gear-cases have ninety-seven holes drilled simultaneously by a Zagar multiple-spindle drill head. A different head substituted on the same machine drills the gear-case covers

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(Right) Legs on L-shaped gages are slipped into several slots of the fixture shown to position gages for checking changing contour of dies for turbine buckets and blades

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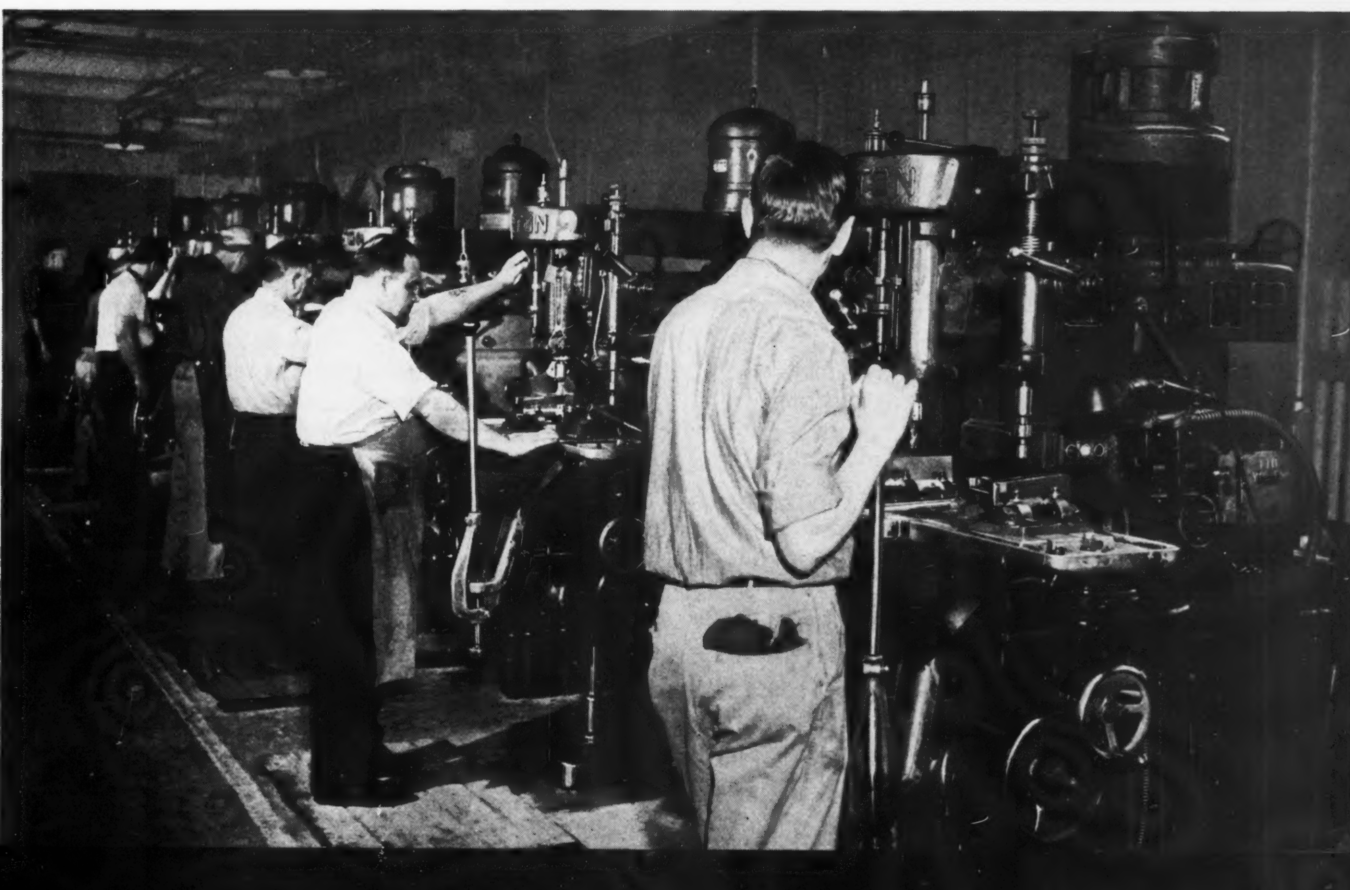
(Below) A double line of Gorton manually controlled duplicators hog out blade and bucket dies for drop-hammer operations



THE SALES ENGINEER AND HIS PROBLEMS

By BERNARD LESTER
Lester and Silver
Sales Management Engineers
New York and Philadelphia

That Delivery is Way Too Long

"Hardly need salesmen today—shops are loaded, deliveries out of sight. Of course, inquiries still have to be answered and orders expedited." I hear superficial thoughts such as these expressed almost every day by the uninformed observer.

Even with a year's average backlog in machinery and tool orders, there is still a vital need for aggressive salesmanship. Only the character and direction of sales effort need to be changed. Failing to recognize this and alter our technique, we are simply headed for trouble.

How can we best meet these changed conditions? What is the answer to the prospect's frequent reply—"Your delivery is too long"? Let us cite three typical examples and spotlight what a proficient and resourceful salesman can do today with a change in selling tactics.

1. A reliable customer has six large grinders installed of my make. He wants two more quickly. Competitor's delivery time is six months—mine is eight months.

Here are some suggestions on handling the situation:

Is there any chance to help the customer rearrange his machining operations to relieve, for the time at least, so large a demand for grinding?

What can be done to help the customer get greater output from the present grinders?

Is it feasible for the customer to sub-let or contract a part of his grinding operations?

Can I prove my quoted date of delivery is more reliable than that promised by my competitors?

Can I explain why my delivery is longer? This may be due to superior design, workmanship, and testing of the machines—all of which might justify a longer delivery.

Do I evaluate performance of my machine compared with my competitor's? Every day the street shopper delays buying to get what is best.

2. An old and valued customer needs a batch of varied tools for a new shop set-up. He must get going. You, as a distributor—among others—are bidding.

Do I simply review the list of tools required and set down my delivery and price against those of competitors? Or do I make a careful review of the customer's over-all problem and lay-out, in which case I help solve his problem rather than only offer him the tools.

Do I try to help locate individual tools elsewhere, irrespective of make, when my delivery is abnormally long?

Do I sell the advantages of individual responsibility for the entire installation, rather than simply for one or more tools?

Do I carefully evaluate all matters of transportation, mounting, wiring, tooling, and breaking in hands? All of these mean time consumed in getting going. If expedited, they might offset the delivery differential on the tools themselves.

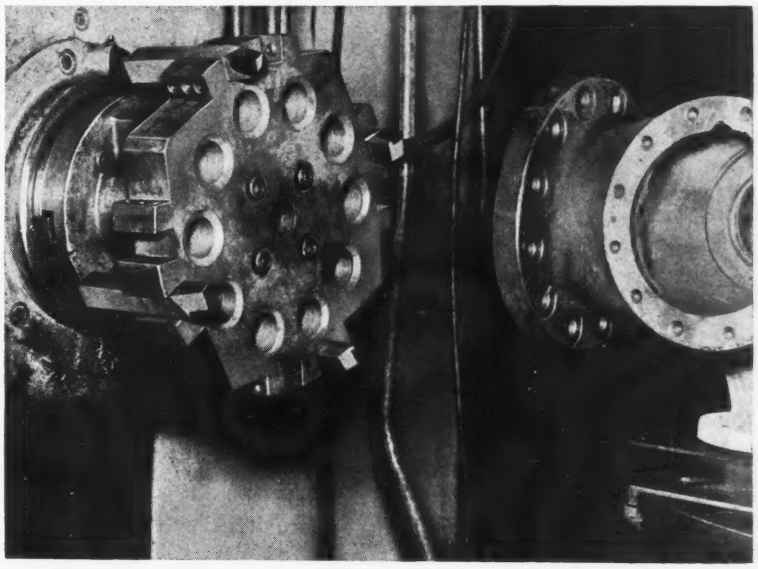
3. One of my high-grade customers has bought three quite special tools I have designed and built. Engineering was a big element in time and cost. Now he needs others. Delivery is naturally long. He can't even interest competitors. What can I do?

Today engineering time is at top priority and increasingly costly. Do I explore all ways and means to do the job, perhaps temporarily returning to methods used some years ago?

Do I survey the field of materials now used by the installed tools, with the thought that different materials might satisfy his needs and also simplify his operations?

These simple citations are abc's to many a salesman. With rapidly changing conditions, what we all need today is:

Increased resourcefulness, closely combined with foresight.



Four carbide cutters mounted on a fly-cutting head machines castings in one pass instead of the two passes formerly required with a conventional milling cutter

Exhausting of every effort before we say "It can't be done."

Forgetting prejudices and taboos that have ordinarily characterized competitive selling.

Joe Kirkwood—the golfer—in one of his trick demonstrations, would drop a row of balls on the turf. Lining up a group of caddies a few yards away he offered each one a dollar if he caught a ball. Then he would chip off the balls like lightning right at the waiting caddies. Each caddy grabbed out in confused anxiety. Few balls were caught because no caddy selected one ball and concentrated on catching that one.

It's the same way with a multiplicity of potential machinery orders. Wise choice and close concentration yield the best results. For after all, which, in the long run, is of greater value—a miscellaneous order or a continuing customer?

Carbide Lathe Tools Used in Milling Cutter

A turbine casting that formerly required two passes for milling with a conventional type cutter is now milled in one pass by the substitution of four standard Carboloy lathe tools mounted on a fly-cutting head, originally designed for use as a regular fourteen-blade milling cutter. The illustration shows the tool set up in the Fitchburg, Mass., plant of the General Electric Co.

The operation is performed on a Sellers horizontal boring mill equipped with a 5-inch spindle and driven by a 15-H.P. motor. The Carboloy cutters remove 1/2 inch of material, the tools being set so that the cut is broken up into four steps, each 1/8 inch deep. No difficulty is experienced in taking the entire cut in one pass.

Attending a recent dinner given by the American Ordnance Association at the Waldorf-Astoria in New York, in honor of the U. S. Marine Corps, were (left to right) E. R. Godfrey, vice-president of General Motors; Louis Polk, president, the Sheffield Corporation; General Clifton B. Cates, U. S. Marine Corps Commandant; and Colonel James L. Walsh, president of the American Ordnance Association. General Cates was the principal speaker. Louis Polk was elected a member of the National Council, a director and vice-president in charge of Technical Committees and Divisions of the American Ordnance Association, while E. R. Godfrey was elected a member of the National Board of Directors

Wide World Photos

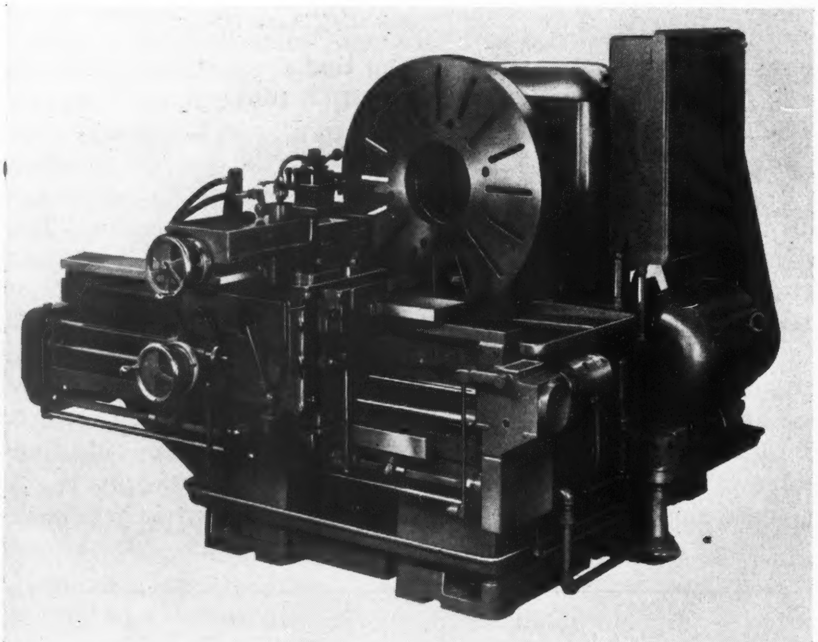
The Latest in Shop

Machine Tools, Unit Mechanisms, Machine Parts, and Material-

Lodge & Shipley Right-Angle Chucking Lathes for Jet-Engine Production

The Lodge & Shipley Co., Cincinnati, Ohio, in cooperation with engineers of the Pratt & Whitney Aircraft Experimental Division, has developed a chucking lathe of radically new design for facing, turning, and boring such large-diameter, turbo-jet engine parts as turbine shroud rings, turbine labyrinth seals, nozzle guide-vane support rings, outer nozzle rings, and turbine stator rings.

The machining of these thin-walled jet-engine components is of a sensitive, precise nature, requiring relatively little power. However, special facilities for holding the work and applying the cutting tools are necessary for efficient handling of this comparatively new class of work. The right-angle chucking lathe developed to meet these requirements has a carriage mounted on a T-shaped bed at right angles to the headstock, as shown in the accompanying illustrations.



Although these machines have been especially designed for the production machining of turbo-jet engine parts, they are adapted for turning, facing, and boring other large-diameter, thin-walled, short-length work, such as aircraft, rocket, guided-missile, and similar shaped parts.

Loading and unloading of the work are easily accomplished on the new machines. The controls are all located at the apron position on the front of the machine, so that the operator always has a clear view of the cutting tool and can easily inspect and gage the work. The portion of the T-shaped lathe bed on which the carriage is mounted is located at right angles to the center line of the lathe to facilitate rapid, accurate machining of the face of the work at right angles to its axis.

The facing carriage has a forward travel of 31 inches from the center line, as well as a backward travel of 6 inches from the center. The top slide has a forward travel of 12 inches and backward travel of 4 inches. It is provided with power angular feed in any direction for use in performing either straight or taper boring or turning operations.

In Fig. 3 is shown a close-up

Fig. 1. (Above) Lodge & Shipley right-angle chucking lathe designed for machining jet-engine parts

Fig. 2. (Below) Taper-boring a turbine shroud ring for aircraft jet engines

Equipment

Edited by FREEMAN C. DUSTON

Handling Appliances Recently Placed on the Market

view of the set-up employed for taper-boring the turbine shroud ring for a jet engine. The shroud, made from stainless steel, has a maximum diameter of 48 inches, a width of about 10 inches, and a wall thickness of approximately 2 inches. The shrouds are rotated at a surface speed of 80 feet per minute for both taper boring and taper turning. In both cases, the carbide-tipped tools (Kennametal Grade K3H) are fed at the rate of 0.0113 inch per revolution, with a depth of cut of about 3/16 inch.

A total of twenty-four spindle speeds—varying from 4 to 225 R.P.M.—is available, with maximum powers of from 4 to 15 H.P. Fifty-five feeds—ranging from 0.001 to 0.064 inch per revolution—are provided for the carriage and compound rest. A built-in power rapid traverse moves the carriage in either direction at the rate of 10 feet per minute. The handwheel is automatically disengaged when the power traverse is engaged. Spindle rotation is quickly stopped by means of an electric brake.

A hollow-spindle type headstock was provided on the machine shown to accommodate workpieces having extensions that are not to be machined. However, a conventional headstock is supplied for cases where the work can simply be clamped to a faceplate. Maximum swing over the bed is 60 inches. A direct reading dial and counter indicate the diameter being machined, and another direct reading dial shows the length of cut. Also, hardened and ground pads are provided on both sides of the facing carriage for use in setting up with gage-blocks. The lathes can be equipped with a hydraulic duplicating attachment for accurately reproducing parts from a templet.

A very important advantage of these right-angle T type chucking lathes is the comparatively small amount of floor space required. A battery of five of these lathes, for example, is said to make possible a saving of approximately 50 per cent in floor space as compared with conventional types of machines of sufficient capacity to handle work of the kind for which the new lathes have been developed. The shipping weight of the new machine is about 17,700 pounds. 62

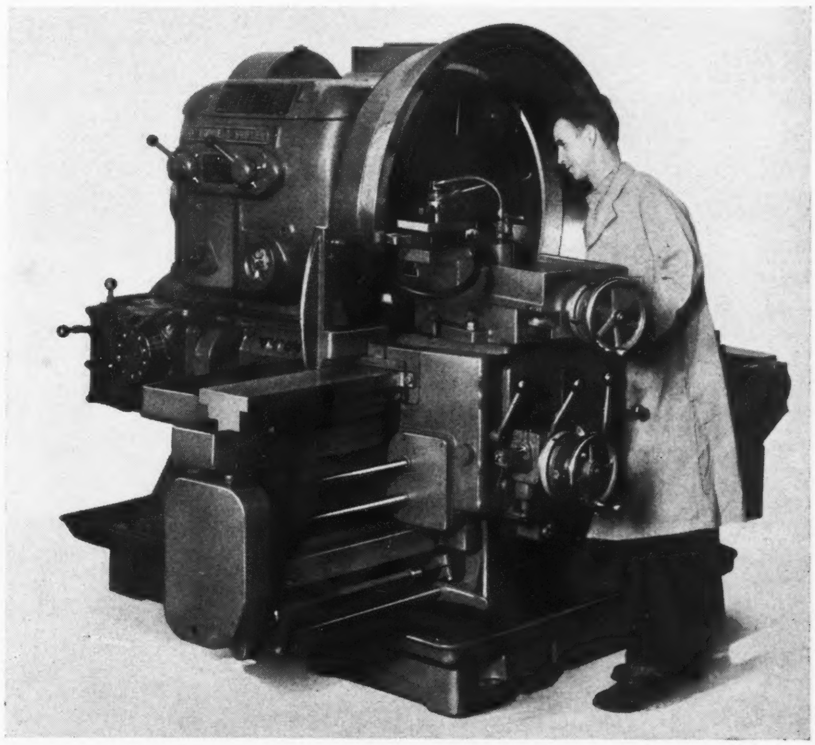
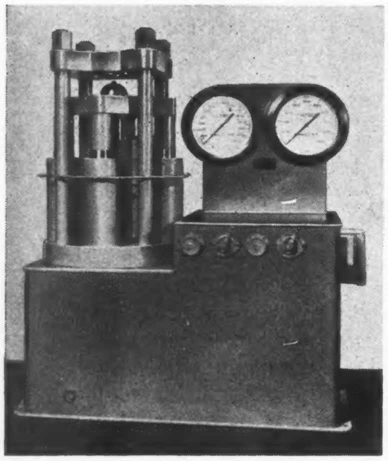


Fig. 3. (Above) Right-angle chucking lathe shown in Fig. 1, set up for machining a jet-engine part

Fig. 4. (Below) Taper-turning operation on a stainless-steel jet-engine shroud

To obtain additional information on equipment described here, use Inquiry Card on page 227.



Ductility testing machine built by Steel City Testing Machines to detect surface and sub-surface imperfections in deep-drawing steel

Ductility Testing Machine

A ductility testing machine which has a total capacity of a quarter of a million pounds pressure and incorporates a unique 5-inch diameter penetrator has been built by Steel City Testing Machines, Inc., Detroit, Mich., for the Fontana Works of the Kaiser Steel Corporation. This machine is designed to detect surface and sub-surface imperfections in deep-drawing steel over a comparatively large area.

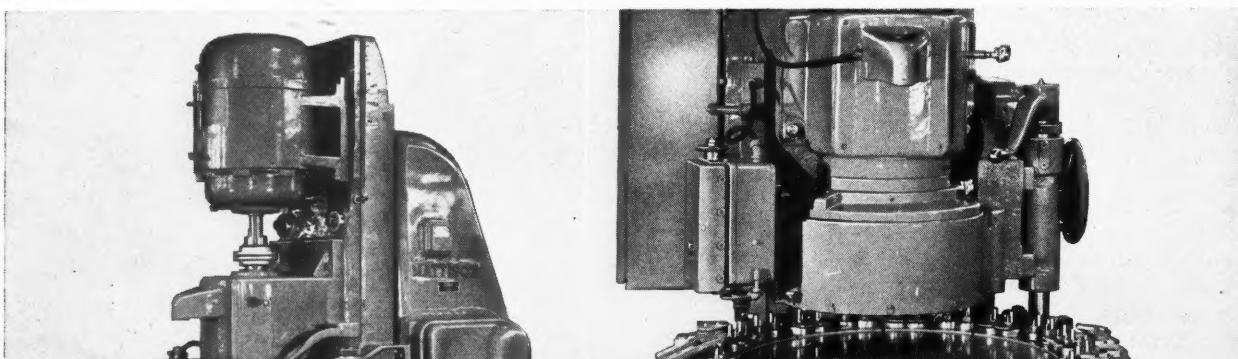
It is motorized, hydraulically operated, and provides separate controls for clamping the sample and for regulating the penetrating pressure. Any desired penetrating pressure up to 150,000 pounds and clamping pressure up to 100,000 pounds can be applied. A set of three dies is provided for testing material of different thicknesses up to 1/4 inch.

Although the conventional 7/8-inch diameter penetrator used in most ductility testing machines satisfactorily determines the ductility of steel, it was considered that cup testing over a large area would afford a greater opportunity of detecting surface and sub-surface imperfections. A 7/8-inch diameter extension on top of the 5-inch diameter penetrator affords an opportunity of comparison with the 7/8-inch standard. As an aid in the evaluation of results, the area involved in the test is inscribed with a 1-inch grid which can be correlated to, or made to correspond with, the grid pattern of drawn parts. 63

Surface Grinder with Special Fixture for Grinding Both Ends of Oil-Pump Gear

The Mattison Machine Works, Rockford, Ill., has recently completed a specially equipped No. 24A Hanchett type rotary surface grinder for finishing both ends of automotive oil-pump gears. A general view of the complete machine is shown at the left in the accompanying illustration, while a close-up view of the fixture with the guards removed is shown at the right.

The fixture has two sets of work-holding stations, the gears being transferred from one set of stations to the other in a reversed position as fast as they are ground on one end. The first-operation stations are reloaded as rapidly as the gears are removed and transferred to the second-operation stations. The gears are automatically ejected from the second-operation stations with both ends finish-ground. An automatic sizer is constantly in operation, which checks the work and keeps all pieces within the specified tolerances without the operator's attention. 64



(Left) Mattison Hanchett type rotary surface grinder. (Right) Close-up view of special fixture of machine shown at left, which is designed for production grinding of both ends of oil-pump gears

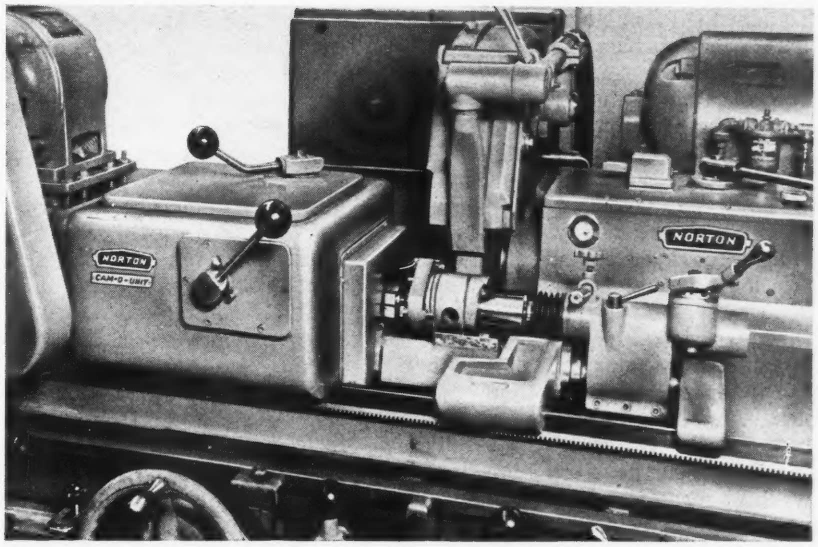
To obtain additional information on equipment described here, use Inquiry Card on page 227.

Norton Piston-Grinding Unit

A new unit for grinding automotive or other types of pistons where a tapered relief form is required has been brought out by the Norton Co., Worcester, Mass. This unit grinds the piston to the desired shape while it is held between centers, with the head end of the piston carried in a dog or holder, and centered on the master cam spindle center.

The bottom end of the piston is supported on a special footstock center carrying a spherical ball bearing. The footstock in which this center seats does not rock, as it is mounted on a stationary member of the machine instead of on a rocking bar, as in normal cam or shape grinding practice. The spherical ball bearing on the footstock center thus becomes a pivot about which the piston revolves and oscillates according to the motion imparted to the rocking bar by the master cam. In and out motion at the footstock pivot is zero, since this is a stationary point.

With this arrangement, the motion and corresponding amount of piston relief that is ground at any point between the centers is proportional to the distance from the footstock pivot. Thus a greater amount of relief is ground at the head of the piston than at the bottom of its skirt, which is nearer the pivot. 65



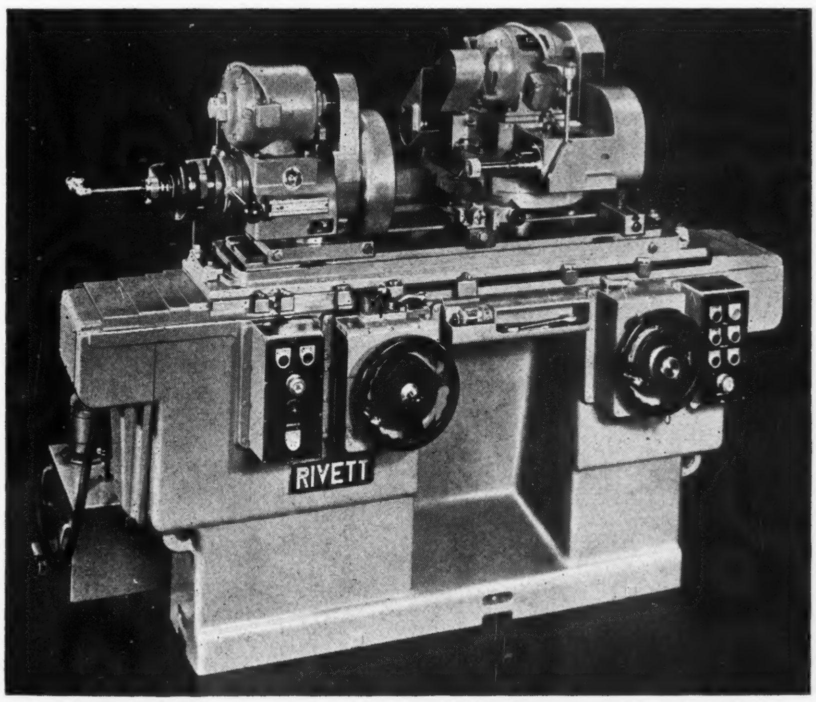
Piston-grinding unit brought out by the Norton Co.

Rivett Hydraulic Grinder with Improved Universal Wheel-Head

Both internal and external spindles are mounted on the swiveling wheel-head of the new 1024 hydraulic grinder placed on the market by Rivett Lathe & Grinder, Inc., Boston, Mass. The improved wheel-head swivels 180 degrees and is designed to eliminate dual work set-ups for internal and external grinding and to permit the operator to quickly present either spindle to the same work.

This machine has been constructed to perform all types of grinding, including internal grinding of small, large, and deep holes; external grinding of straight and long shafts; and shoulder grinding of shafts having cylindrical sections of different diameters. A feature that provides greater accuracy and speed is the mounting of draw-in collets and step chucks directly in the lathe type work-head and the operation of a lever closer to reduce chucking time.

Other features of this grinder are internal spindle speeds of 6000 to 35,000 R.P.M.; spindles flange-mounted, sealed from grit, and life lubricated; external spindle with double-row roller bearings for radial load and ball bearings for end thrust; micrometer table stop and fine feed for shoulder and blind-hole grinding; sine bar for setting work-head on table swivel for accurate taper grinding; double swivels on cross-slide for two-angle internal and external grinding; and grinding-wheel feed controls at operator's right hand, with table controls at his left...66



Universal hydraulic grinder of improved design announced by Rivett Lathe & Grinder, Inc.

Special Lubricant for Machine Tool Table Ways

A special lubricant for machine tool ways, known as "Febis K-53," has been developed by the Esso

To obtain additional information on equipment described here, use Inquiry Card on page 227.

Standard Oil Co., New York, N. Y. This new lubricant is especially adapted for use on the ways of lathes, planers, and grinders. It meets the requirements of the Cincinnati Milling Machine Co.'s Specification P-47 for a lubricant of this type. To meet this specification, a table-way lubricant must have a coefficient of static friction lower than its coefficient of kinetic, or sliding, friction; that is, the force required to start one surface moving in relation to the other must be less than that necessary to maintain movement between the two surfaces. This lubricant has high resistance to washing away from metal surfaces and is a mild rust preventive......67

Lempco Supersize Diesel Crankshaft Grinders

A new series of supersize precision crankshaft grinders that will handle Diesel-engine crankshafts up to 18 feet long has been introduced by Lempco Products, Inc., Bedford, Ohio. The huge grinding wheel—4 1/2 feet in diameter on the largest model—is moved hydraulically on precision ways from journal to journal at speeds of 1 inch to 35 inches per minute. Hydraulic controls are also used to obtain rapid, smooth approach and retraction movements of the grinding wheel.

Adjustment for various lengths of crankshafts is made by moving the headstock, the final setting being made at the tailstock through an adjustable quill. Head and tailstock spindles are mounted in Timken bearings 12 1/2 inches outside diameter. The shaft is held by 24-inch pot chucks, and the main bearings are ground between centers.

The machine has an over-all height of 7 feet. The work is placed at eye level, and electrical controls are located at the operator's finger tips.

The new machine is available in three models, accommodating crankshaft swings ranging from 32 to 50 inches and lengths from 108 to 216 inches. Grinding wheel diameters vary from 36 to 54 inches, with widths from 1 inch to 5 inches. These grinders weigh more than 40,000 pounds. The base is a unit weldment, with hand-scraped ways which are an integral part of the bed. The floor space required is 28 by 8 feet. 68

Giddings & Lewis Electrically Operated Positioning Equipment for Horizontal Boring Machine

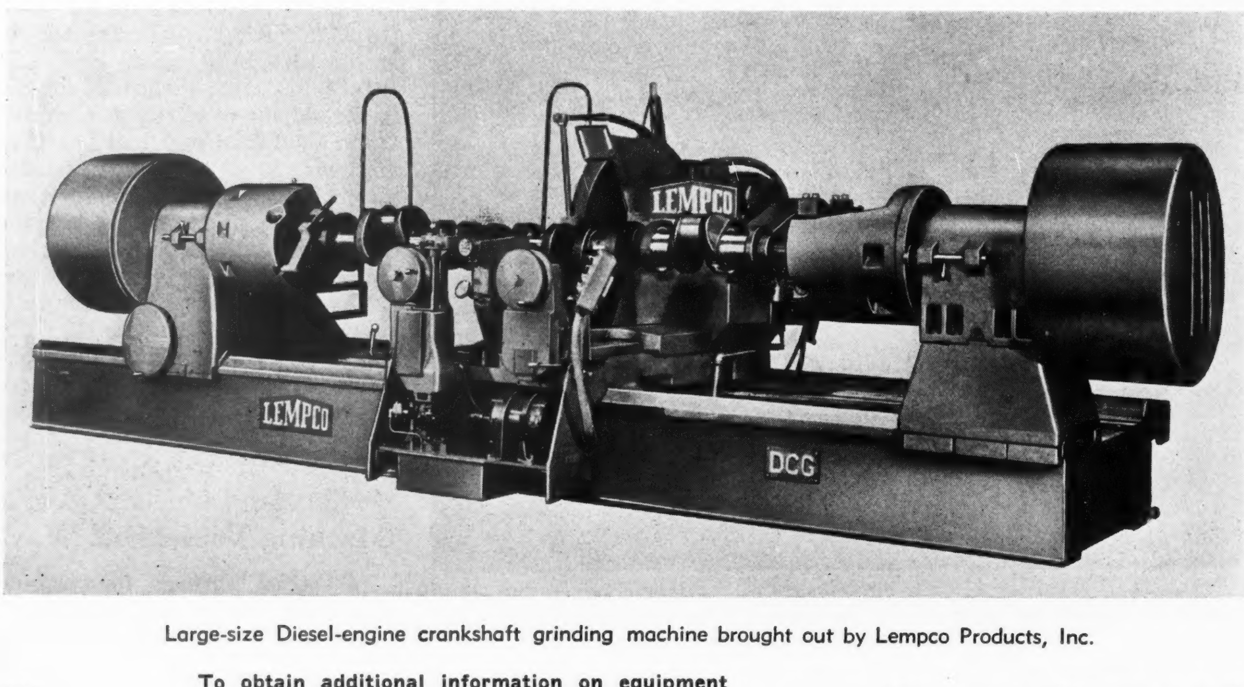
Positive automatic machine settings within 0.0002 to 0.0005 inch are possible with a new electrically operated positioning device developed by the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. By the use of this unit, horizontal boring machine table and headstock fine-feed movements to predetermined settings can be mechanically controlled without final hand adjustments.

Fig. 1 shows the new Giddings & Lewis Series 300-RT rotary table type horizontal boring, drilling, and milling machine equipped with the automatic positioning equipment consisting of a constant-speed motor gear reduction unit and magnetic clutch *A* used to drive the machine feed-screw; a selector switch and dial indicator *B* for the headstock; a vertical shaft *C* for holding measuring or job rods; an adjustable stop *D;* saddle supports and runways *E*.

In Fig. 2 are shown the dial indicator, selector switch, and adjustable stop arrangement of the vertical movement control on the headstock of the machine. Fig. 3 shows the precision measuring rod in place on the table of the machine, with the trip selector switch that actuates the automatic positioning device.

Although the positioning device is designed as a standard accessory for table type machines equipped with saddle supports and auxiliary runways, it is equally well suited for use on machines employed for a single work-piece requiring a series of bores, or for a number of parts produced in job lots. Besides reducing work setting time, the device lessens the need for special jigs and fixtures.

The automatic positioning device consists of two complete control units, one for the lateral setting of the table on the saddle and



Large-size Diesel-engine crankshaft grinding machine brought out by Lempco Products, Inc.

To obtain additional information on equipment described here, use Inquiry Card on page 227.

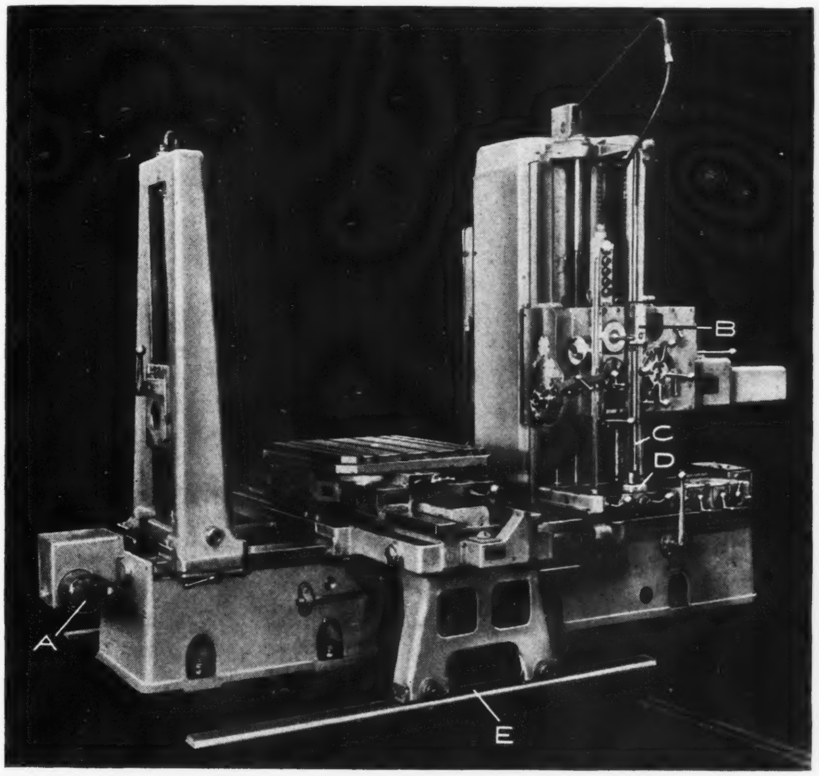


Fig. 1. New Giddings & Lewis rotary table type horizontal boring, drilling, and milling machine equipped with automatic positioning device

the other for the vertical setting of the headstock on the machine column. These units can be operated individually or simultaneously, depending upon the requirements. When components of the positioning device are actuated, they disengage the table and headstock rapid traverse directional controls and then automatically position the table or headstock in its final setting.

In using the automatic positioning device, a starting point is determined at any convenient position on the face of the workpiece. Measurements are then made from this point with conventional type end-measuring rods if a single part is being precision-bored. For production work, a "job rod" with various bored spacing holes for stop-pins on each of its four sides is used to simplify duplicate settings.

After the desired travel has been determined and the rods are in place, machine directional controls are manually connected. The machine table and headstock move in rapid traverse until the directional clutches are automatically disengaged by a selector switch in the precision measuring device. There is a slight over-travel of the table or headstock of approximately 0.005 to 0.010 inch at this point in the positioning cycle.

During this interval of travel, a master electrical switch is energized, which starts a constant-speed motor connected to a reduction gear unit. Through a magnetic clutch attached to the reduction unit and the machine feed-screw, the table and headstock are then automatically returned by fine feed to within 0.0002 to 0.0005 inch of the desired machine setting. When this precise point is reached, as shown on the dial indicator, the magnetic clutch is disengaged. The indicator is used only for the first setting, after which it merely serves as a reference gage. 69

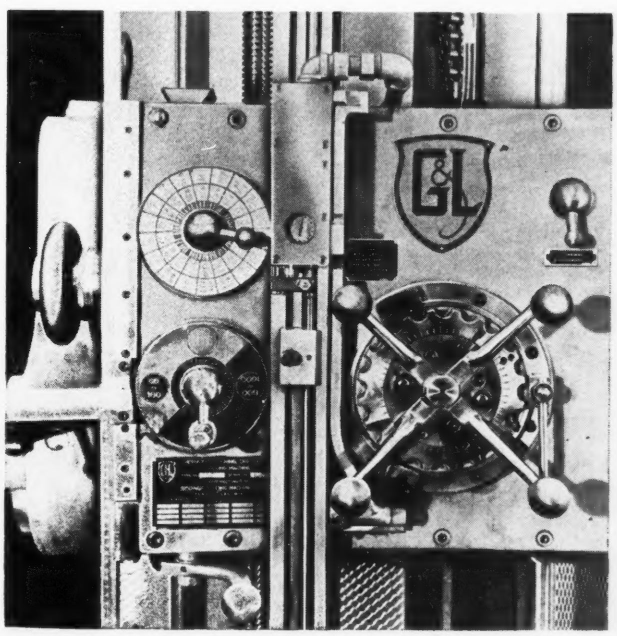


Fig. 2. Close-up view of dial indicator, selector switch, and adjustable stop arrangement of headstock vertical movement control

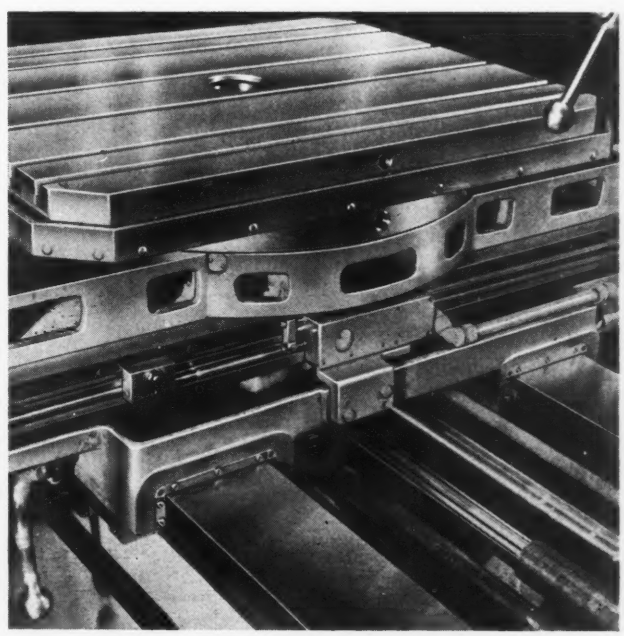


Fig. 3. Close-up view showing precision measuring rod in place on table of machine equipped with automatic positioning dev'ce

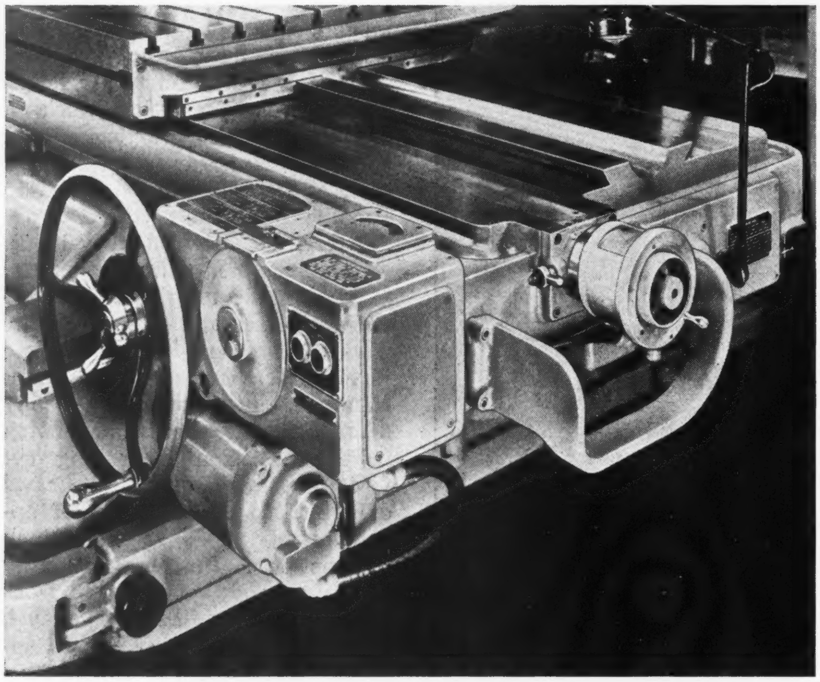


Fig. 1. "Electrolimit" measuring equipment for precision locating of table and work now available on Pratt & Whitney jig borer

P & W Jig Borer with "Electrolimit" Measuring System for Precision Locating

The huge No. 4E jig borer announced by Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford, Conn., employs an entirely new measuring system for accurately locating large work under the machine spindle, designated the "Electrolimit" measuring system. This machine incorporates certain features of the Pratt & Whitney "Electrolimit" gaging principle.

Basic 1-inch spacing is obtained from a master measuring bar by electrical means without making physical contact with the bar. The master bar, shown diagrammatically in Fig. 2, has rectangular projections which are calibrated so that the distance between the magnetic centers of adjacent projections is precisely 1 inch, within a tolerance of twenty millionths inch accumulated error in the full length of the bar.

Two of these master bars are built into the machine at right angles with each other. These bars are permanently sealed and protected. One bar (60 inches long), located on the under side of the table, is used for positioning the table longitudinally. The other bar (36 inches long), on the under side of the carriage, is for positioning the table transversely. Beneath each master bar is an electromagnetic head which detects the exact magnetic center of each projection on the master bar as the bar passes over the head, and registers a zero indicator reading.

The basic 1-inch spacing is further subdivided by positioning the electromagnetic head between any two projections on the master bar with a high-precision micrometer screw. A 4 1/2-inch diameter micrometer barrel, with wide-spaced graduations, permits easy reading for direct settings to 0.0001 inch. A separate screw, within the micrometer screw, is used to locate the electromagnetic

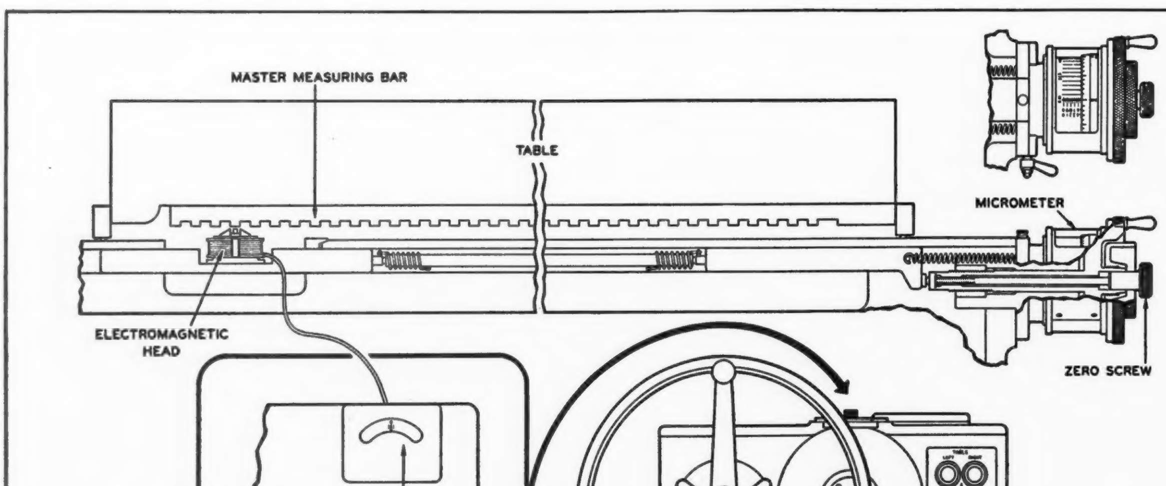


Fig. 2. Diagram illustrating "Electrolimit" measuring system for precision locating of table and work incorporated in Pratt & Whitney jig borer

To obtain additional information on equipment described here, use Inquiry Card on page 227.

head under the nearest projection on the master bar when establishing a zero position on work-piece.

Cylindrical reference scales, which revolve as the table or carriage moves, are used to locate the table rapidly to approximate settings. The scales read in either direction, and are adjustable to set zero for the starting position. To locate a hole, the operator simply sets the micrometer for the inch fraction and operates the power rapid traverse until the reference scale reads the approximate setting. Final adjustment is made by handwheel, the exact setting being accomplished when the indicating meter reads zero.

As the traversing screws of the two slides have no connection with the measuring system, errors in the screws, backlash, or wear cannot affect the accuracy of the setting. The master measuring bars are sealed in the machine, protected from dirt and chips, and since measuring is accomplished without making physical contact, they are not subject to wear.

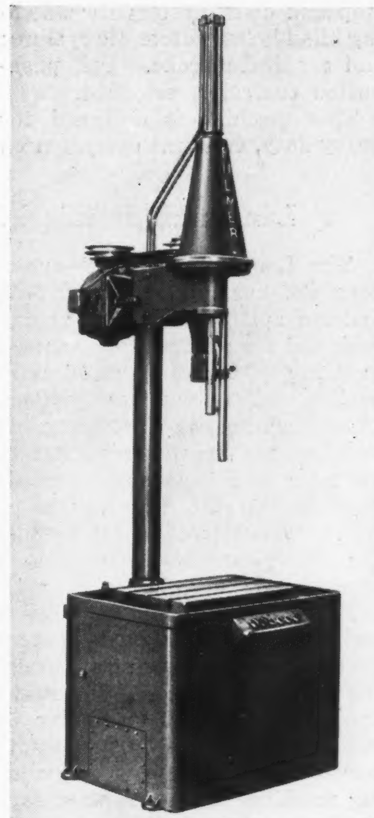
The high-precision micrometer screws are only utilized to position the small electromagnetic heads, which require a force of only a few ounces. As the scales are graduated to read from zero in either direction, locating can start from either end or from the center of the work. 70

Cleveland "Visual-Grind" Contour Grinding Machine of Improved Design

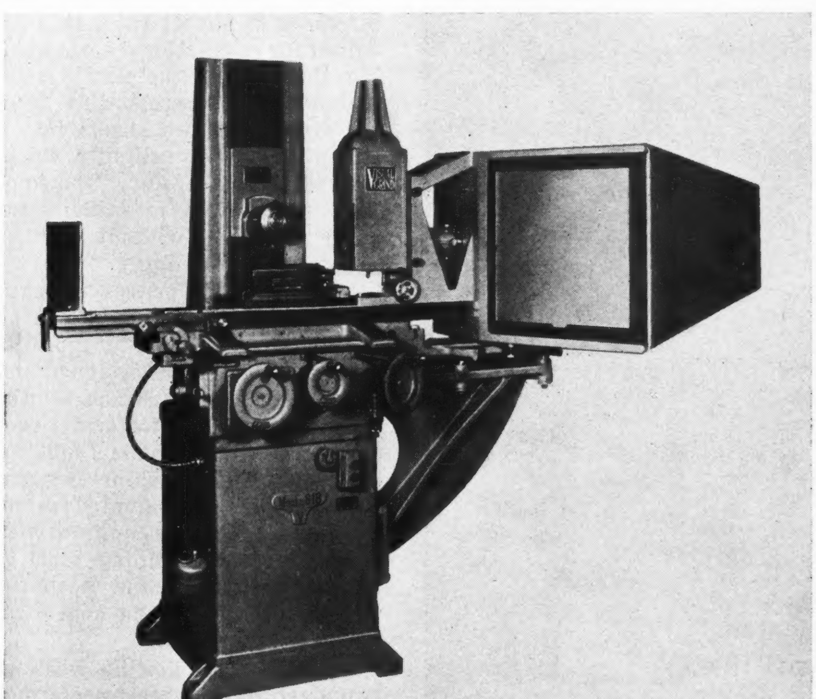
Improvements in design and construction have recently been incorporated in the "Visual-Grind" contour grinding machine manufactured by the Cleveland Grinding Machine Co., Cleveland, Ohio. The support for the entire optical projection section of the improved machine now consists of a heavy aluminum-alloy casting.

Improvements in the optical system include fins in the lamp housing, designed to increase radiation and dispersion of heat and thus lengthen lamp life; a handwheel, worm-gear, and screw for raising and lowering the lamp housing on dovetail ways; and a pre-set lens tube to insure accurate, positive focus.

The longitudinal and cross traverse movements of the optical section are facilitated by hardened steel ways and rollers. Easy adjustment of the entire optical system is obtained by complete counterbalancing. Variable-power longitudinal feed of the table relieves the operator of hand-feeding during the rough- and finish-grinding operations. One-shot lubrication is now provided as a regular feature of these contour grinding machines. 71



Fulmer push-button controlled honing machine for finishing deep holes



Improved contour grinding machine built by Cleveland Grinding Machine Co.

Fulmer Heavy-Duty Honing Machine

The C. Allen Fulmer Co., Cincinnati, Ohio, has brought out a Model 415 honing machine designed to finish bores from 1/4 inch to 4 inches in diameter that are too long to be handled by the Model 412 honing machine previously introduced by the company. The new machine has a working stroke of 15 inches. It has a heat-treated alloy-steel spindle 1 1/4 inches in diameter. The spindle is driven by a 3-H.P. motor through reduction gears, which provide three spindle speeds.

The hydraulic reciprocating equipment consists of a 2-H.P. motor driving a Vickers pump and controls that permit the use of reciprocating speeds from 1 to 70 feet per minute. The spindle and honing tools are hydraulically counterbalanced.

The standard height under the spindle nose of this machine is 40 inches. The work-table has three 5/8-inch T-slots. A special table with a built-in indexing fixture for holding automotive cylinders can be supplied if required. Other extra features include the Fulmer

To obtain additional information on equipment described here, use Inquiry Card on page 227.

stop and dwell system for finishing blind holes; automatic cycling; and a spindle brake. Full push-button control is provided.

This machine is designed for heavy-duty, constant operation on small, precise work, and is so arranged that job change-overs can be easily and quickly made. Various types of fixtures are available, along with honing tools 1/4 inch in diameter and up. 72

Landis Hydraulic Piston-Grinding Machine

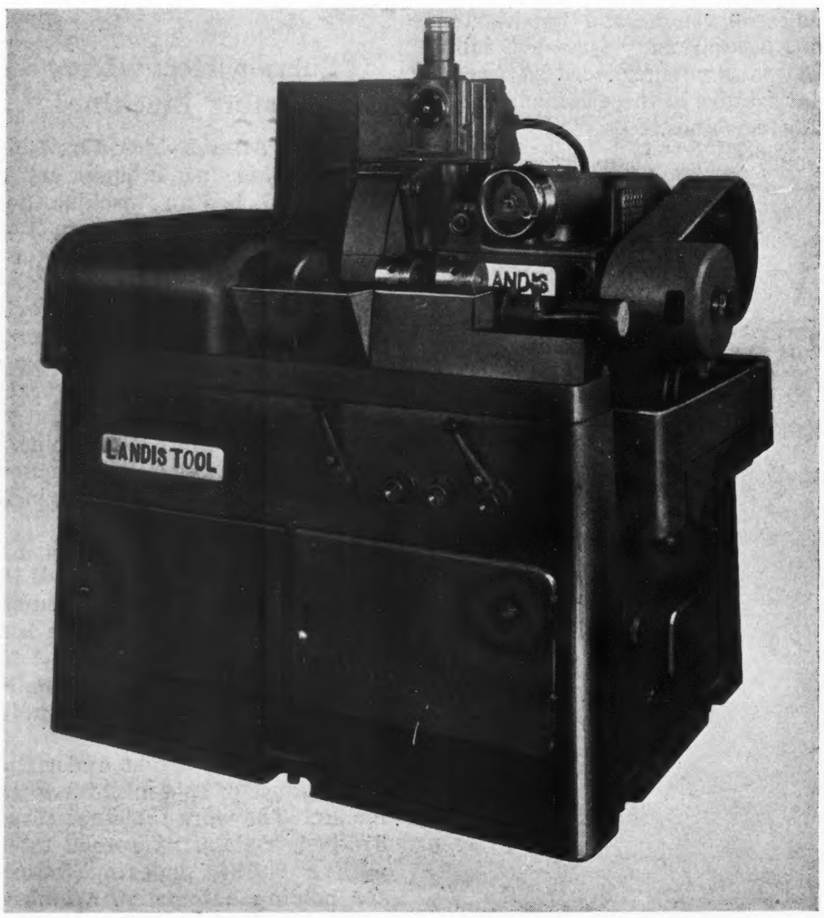
The Landis Tool Co., Waynesboro, Pa., has announced a Type H hydraulic piston-grinding machine designed for accurate, economical grinding of the cam-shaped skirt portion of automotive pistons. This machine has a capacity for grinding pistons with a maximum diameter of 5 inches and a maximum length of 8 inches. One of its many outstanding features is the provision for operation on a semi-automatic cycle.

The piston-grinding unit has a rocking action designed to produce the required cam contour on the skirt of the piston. The mechanism of this unit is similar in design to that used on the Landis semi-automatic cam-contour grinding machine. A new type of tapered master cam is used, however, so that the difference between the two axes of the skirt can be varied as required.

The standard wheel is 24 inches in diameter, has a 3 1/4-inch face, and is driven by a 7 1/2-H.P. motor. This wide-face wheel facilitates grinding pistons by the plunge-grind method. The machine can also be arranged for traverse grinding of pistons. When using the traverse grinding method an automatic feed operates at each reversal of the traverse movement until the piston has been ground to the finish size.

When a plunge grinding cycle is employed, the feed is continuous until the predetermined size is reached, at which time the feed stops. The wheel reciprocating mechanism incorporated in this machine can be disengaged when not needed. An overhead, hydraulically operated wheel dressing mechanism can be provided, which permits dressing the grinding wheel without disturbing the set-up.

The piston grinder has a new design headstock of the live spindle type with V-belt drive for smooth, even transmission of power to the headstock spindle. A 1-H.P. work-drive motor is used, and plug braking is employed to stop the spindle rotation quickly for loading the work-pieces. 73



Hydraulic piston-grinding machine announced by the Landis Tool Co.

Sciaky Resistance "Mash" Seam Welder

"Mash" welding is a relatively new process of resistance welding technique, employing the use of either a seam or projection type welder to obtain a clean, smooth end-to-end joint. This technique resulted from considerable research conducted for the purpose of eliminating the "flash" made by conventional resistance butt-welding methods.

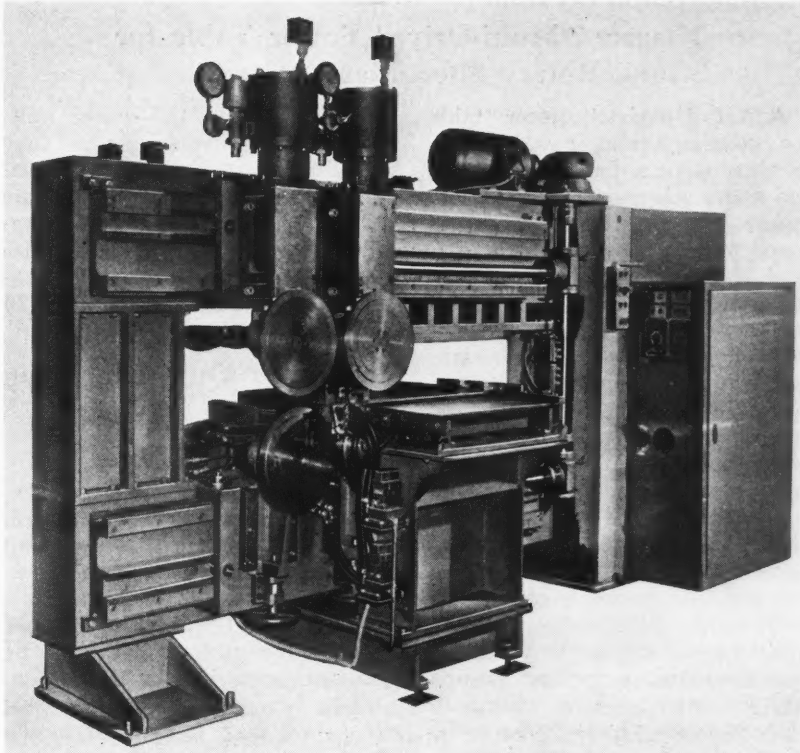
In conventional seam welding, the sheets are usually overlapped 3/8 to 1 inch to guard against sheet deformation and "spitting" of the weld metal at the faying surfaces. In "mash" welding, however, the amount of overlap is limited to approximately 1 1/2 times the sheet thickness, and the welding pressure correspondingly increased to almost twice that required for conventional seam welding, thus forcing the plastic metal without any irregularities from the overlap of two sheets into a single sheet only slightly thickened at the weld joint. The joint in this condition is suitable for many purposes without further grinding or finishing.

The PMM.2TL press type mash welding machine brought out by Sciaky Bros., Inc., Chicago, Ill., has been specifically designed and built for joining 28-inch widths of mild steel sheet to form a continuous sheet for various mill operations. This machine incorporates the Sciaky patented three-phase system, and is equipped with a locating and clamping table to automatically locate the sheets for the proper overlap and hold them securely for welding.

Immediately following welding, two steel idling wheels perform a rolling operation which reduces the overlap of the two sheets to a minimum thickness. This thick-

To obtain additional information on equipment described here, use Inquiry Card on page 227.

ness can also be controlled by varying the amount of pressure provided by the upper head assembly. In actual operation, the operator need only insert the ends of the sheet to be welded to a stop between the electromagnetic clamping bars and depress a control button, which clamps the sheets securely and rocks the clamped parts with a preadjusted overlap to the welding position...74



Resistance "Mash" seam welder brought out by Sciaky Bros., Inc.

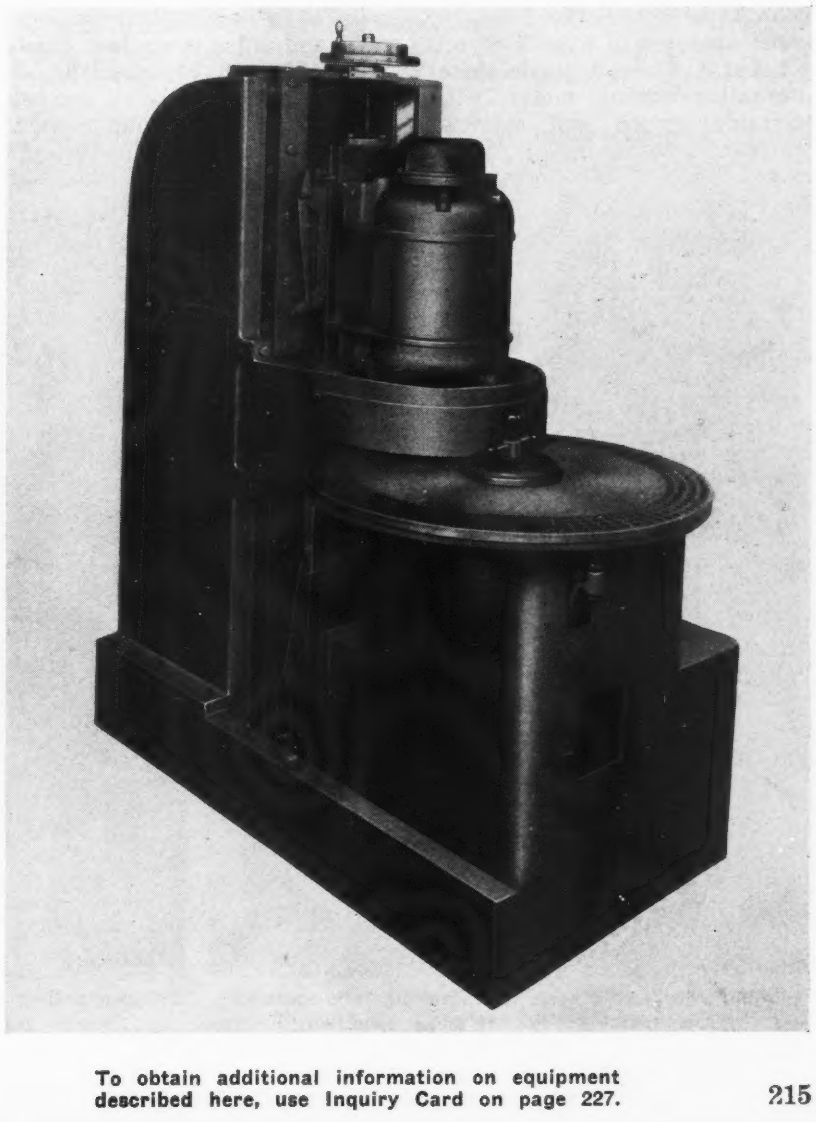
Double-Disk Precision Grinding Machine

The Gardner Machine Co., Beloit, Wis., has just announced a new double-disk grinding machine designed to grind two parallel flat surfaces on small work-pieces in one operation. Small coil springs, carbon brushes, ceramic pieces, and similar parts are typical of work that can be economically finished on this Model 2V-18 machine. The two abrasive disks are 18 inches in diameter by 2 inches thick, and each is driven by a 3- or 5-H.P. motor.

The 32-inch diameter rotary work-carrier is made to suit the types and sizes of work-pieces to be ground. Finger-tip control is provided for an infinite range of work-carrier speeds between 1/8 and 1 R.P.M. A bayonet lock for the rotary work-carrier permits rapid change or removal of the carrier plate for changing the work set-up or dressing the disks. An outboard bearing under the work-carrier provides extra stability for the flat revolving plate.

The grinding heads can be independently adjusted by means of graduated handwheels. Each head can also be tilted for jobs requiring progressive grinding of the work-piece. The path of the work is directly across the center of the abrasive disks. With this method, a solid disk, without a center hole, can be used. This results in considerable savings in wheel cost, since less frequent dressings are required.

The dresser mechanism enclosed in the main machine column is hand-operated and fully adjustable. As dressing is done across the center of the disk, no compensating settings are needed when the heads are tilted..........75



Gardner double-disk grinding machine designed for finishing two parallel flat surfaces in one operation

To obtain additional information on equipment described here, use Inquiry Card on page 227.

Niagara "Multi-Drive" Power Table for Rotary Sheet-Metal Work

A "Multi-Drive" power table for beading, crimping, burring, turning, wiring, flanging, edging, and many other sheet-metal operations has recently been introduced by the Niagara Machine & Tool Works, Buffalo, N. Y. This power table has been designed to permit quick conversion of low-cost, hand-operated bench machines to power operation.

Two electric foot-operated buttons on the ends of flexible cable located on opposite sides of the table provide convenient means for controlling the driving motor. This equipment frees the operator's cranking arm, so that he can use both hands to guide the work accurately into the rolls.

With positions on the table for four machines, permanent set-ups can be made which eliminate waste of time in hunting for tools, changing rolls, and setting gages.

The power unit consists of a Niagara worm reduction unit mounted on anti-friction bearings, which operates in a bath of oil. A 1/4-H.P., 110-volt, single-phase, alternating-current motor with reversing switch and overload protection is flange-mounted as an integral part of the power unit. Eight steel universal joints, four coupling shafts, and all electrical equipment are supplied with the table. This equipment can be applied to existing rotary hand machines or supplied with new machines as required. 76

Improved Quill Mounting for Pratt & Whitney Jig Borers

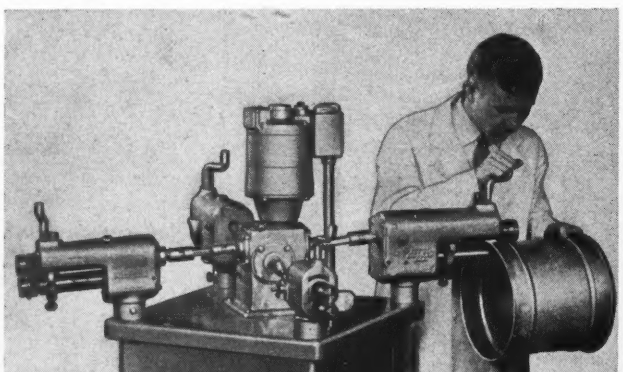
Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford, Conn., has announced a new "ball roll" quill mounting for the spindle heads of its Nos. 2A and 3B jig borers. The construction of the new mounting is shown by the phantom view in the illustration.

Two hardened and ground steel liners are deep frozen, set in the head casting, and then precision-lapped in place. The spindle quill, which is hardened, ground, and polished by hand to extreme accuracy, and a fine micro-inch finish, "roll-feeds" on 240 specially selected precision balls, all preloaded, giving a total bearing pressure of 6000 pounds between the quill and hardened liners. Despite this high bearing pressure, hand operation of the quill is so sensitive that the operator can easily feel a 1/8-inch drill feeding down in the work. A light aluminum bearing cage holds the balls in place in a staggered arrangement, which provides practically a complete bearing around the circumference of the quill.

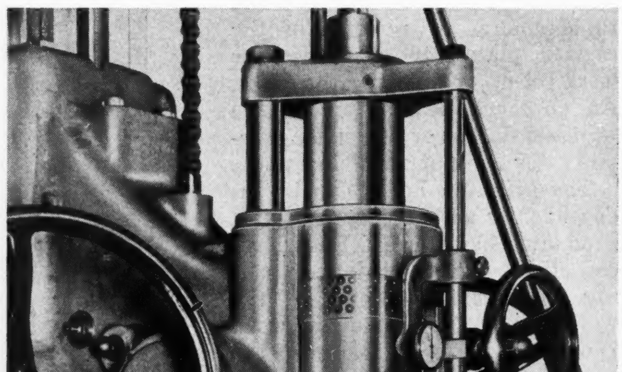
Experimental models of this new design "ball roll" quill with over seven years continuous service in one of the manufacturer's own production departments are said to be functioning within their original fine limits of accuracy. No adjustments or service has been necessary, and no signs of wear are apparent. 77

General-Purpose Electric Heat-Treating Furnaces

The Pereny Equipment Co., Columbus, Ohio, has just introduced the Pereco FG series of electric furnaces in various load capacities. These general-purpose units, equipped with "Globar" heating elements, are designed for heavy, continuous duty at all heat levels up to 2500 degrees F., with higher temperatures available for short or intermittent runs.

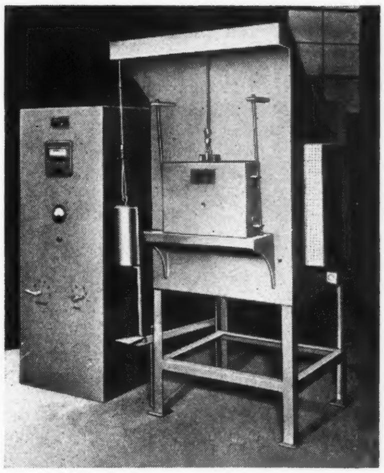


"Multi-Drive" power table for converting hand-operated sheet-metal machines to power operation



Spindle head of Pratt & Whitney jig borer equipped with new design "ball roll" quill mounting

To obtain additional information on equipment described here, use Inquiry Card on page 227.



Pereco general-purpose electric heat-treating furnace

Each furnace has a separate, matching control panel unit, with indicating controller, transformer, current input meter having push-button reading, and magnetic contactor. A wide choice of types of control is also available.

Work areas in the several models of these furnaces range from 8 inches wide, 10 inches deep, and 4 inches high to 16 inches wide, 30 inches deep, and 12 inches high. The counterbalanced door can be raised and lowered by foot-pedal. Standard equipment includes a flame gas curtain, which is automatically ignited as the door is opened and turned off when the door is closed. 78

Federal Continuous Wire Measuring Gage

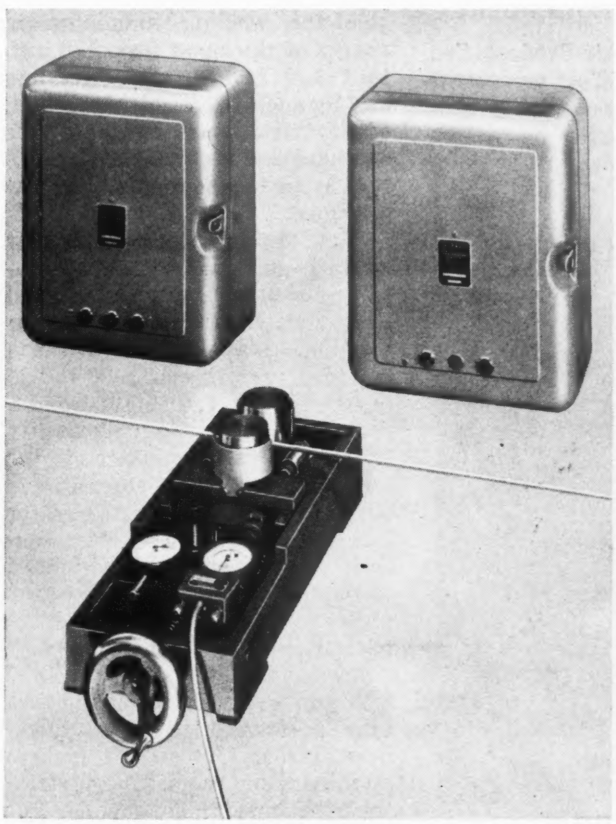
A continuous wire measuring gage that automatically controls the amount of insulating coating applied to extruded wire has been developed by the Federal Products Corporation, Providence, R. I. This gage is designed to handle wire of any size up to 1 inch in diameter. It automatically increases or decreases the speed of the wire as it passes through the extruder.

This assures having the proper amount of insulating material deposited to meet the Underwriters' requirements, and also saves material by preventing excessive amounts from being deposited. All intermittent irregularities that would cause erratic action in the control are dampened out, resulting in a smooth continuous control of the nominal size of the coated wire. 79

Gilmer Timing Belt with Teeth that Eliminate Slippage

The United States Rubber Co., New York City, has developed a rubber and fabric belt with teeth at the L. H. Gilmer plant, Philadelphia, Pa. This new development in power transmission equipment, known as the Gilmer timing belt, is designed to fulfill the need for a power drive that will not slip and will permit split-second precision timing. It will attain speeds up to 16,000 feet per minute, and is said to operate very quietly. The belt can be used as a synchronized conveyor, as well as for transmitting power.

In addition to its anti-slip characteristic and precision timing, the new belt will not stretch. It will operate on fixed centers without take-up adjustments. Since it needs no initial tension, it has unusually high efficiency with extremely low bearing pressure. The belt requires no lubrication, but oil will not harm it. It is unusually compact, and can be used for speed ratios up to 30:1. The extreme flexibility of the belt permits the use of pulleys as small as



Federal continuous wire measuring gage developed to automatically control the amount of insulating coating applied to extruded wire

Close-up view of new Gilmer timing belt and pulleys with teeth designed to prevent slippage and suit wide range of applications

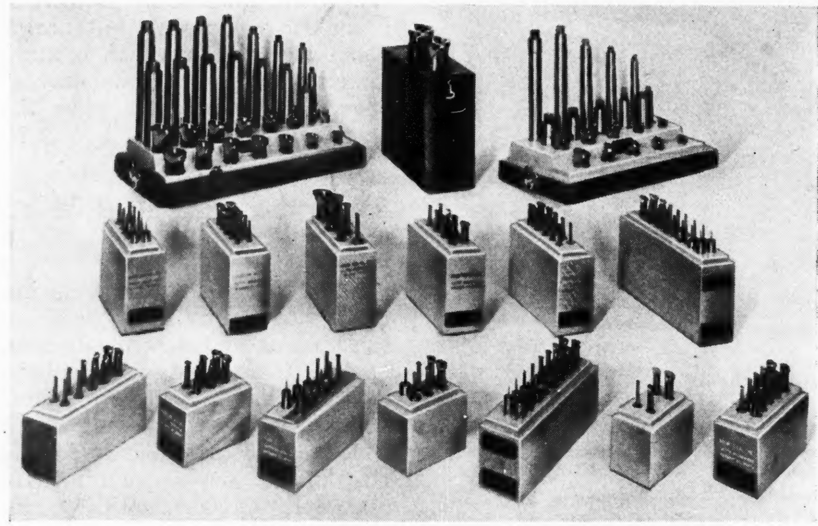
To obtain additional information on equipment described here, use Inquiry Card on page 227.

1/2 inch in diameter at 10,000 R.P.M., even with a heavy load. Machined, die-cast, sintered, or pressed metal pulleys can be used with the new belt. 80

Jig Boring Tool Sets

To facilitate the work of jig boring, the Bokum Tool Co., Detroit, Mich., has made up sets of boring tools to meet varying requirements. This enables each operator to have in convenient, compact form an assortment of tools of only those shank diameters and lengths that he normally requires for his particular work.

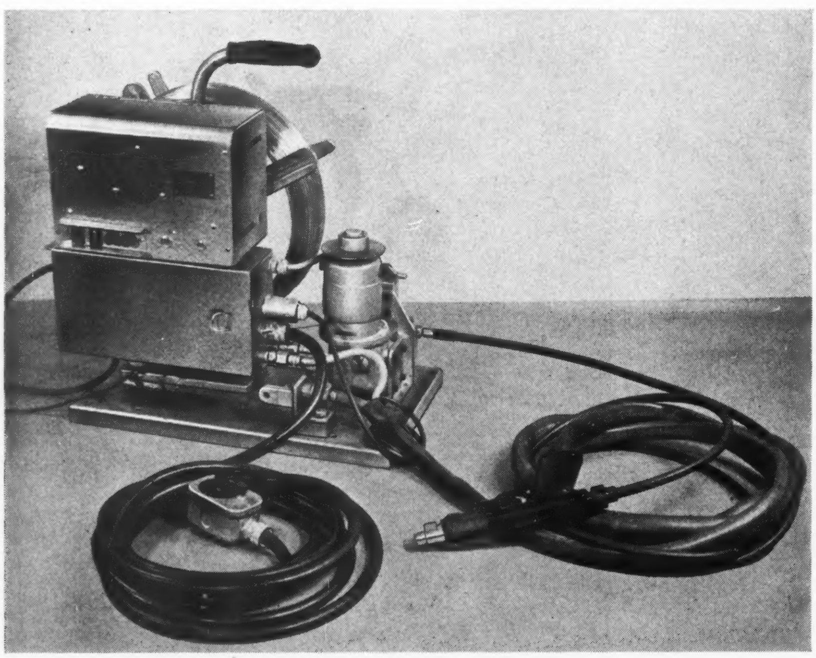
These sets, comprising sixteen different combinations of boring tools, are said to satisfy practically every requirement in any shop, not only with respect to diameters of holes, which may run as small as 1/16 inch, but to depths as well. The larger diameter tools have separate cutters, all interchangeable to fit the shanks supplied. In some cases, two shanks of different lengths are included for each tool. Some sets contain 3/4- and 1-inch adapters to fit 3/8-inch shanks.


Jig boring tool sets made up to suit varying requirements by the Bokum Tool Co.

The Bokum single-point boring tools, distinguished by having the cutting and clearance angles combined in their helical and radial back-off form, make possible the resharpening of the tool on one face only. This assures smooth bores that are free from chatter marks after resharpening, as well as when the tool is new. 81

Linde Argon Metal Arc Hand-Welding Equipment

A new hand torch and automatic wire-drive unit for argon metal arc-welding is a recent product of The Linde Air Products Co., New York City. This equipment has been developed to permit faster welding than is possible with hand welders previously available. The consumable electrode serves as the filler metal, the welding rod being fed from a coil into an argon-protected atmosphere at a steady, predetermined rate.


Linde argon metal arc hand-welding equipment, consisting of electronic governor, gas and electric control, welding rod conduit, welding cable connection, and control for arc and inching

The unit consists of the Linde FSH-4 argon metal arc hand-welding torch and the FSM-2 rod feed unit. It is particularly adaptable for welding aluminum in ranges of thickness from 1/8 inch to 1 1/2 inches. Hand-welding can be applied on butt, lap, fillet, edge, and corner joints in the overhead and vertical positions, as well as in the horizontal and flat positions.

Some of the features of the new welding unit are automatic control of rod feed, argon flow, and cooling water; electronic governor that insures accurate and uniform rod feed (varying from 80 to 380 inches per minute); light-weight, portable construction; flexibility of hose and cable entering the torch handle; pistol-shaped grip of torch, which reduces operator fatigue and provides better control; and other features designed to facilitate setting up. Once the unit has been assembled and the controls preset, operation is very simple.

Argon metal arc welding has been performed on metal thicknesses from 1/16 to 3/4 inch in aluminum and copper alloys, stainless steel, and similar metals. For heavy plate, the multi-pass technique makes possible the welding of any thickness. 82

To obtain additional information on equipment described here, use Inquiry Card on page 227.

"Di-Acro Vari-O-Speed Powershear"

The O'Neil-Irwin Mfg. Co., Lake City, Minn., has brought out a new "Di-Acro Vari-O-Speed Powershear" for high-speed production shearing. The design and construction of this machine provides for full capacity continuous precision shearing within a speed range of 30 to 200 R.P.M. The cutting cycle of the shear can be quickly adjusted to the fastest speed at which the operator can feed the material being sheared.

The speed of the shearing stroke for both continuous and single-cycle operation is positively controlled by a handle located at the operator's left. A non-repeating positive safety clutch, which allows single-stroke operation with the shear blade moving at any desired speed within the range of the unit, is also provided. The extremely slow speeds possible with this "Powershear" provide a sensitive and smooth action for shearing many delicate and unusual types of materials.

The cutting range of the machine extends from the lightest of materials in plastics, fiber, mica, leather, and rubber to heavy gages of aluminum, cobalt steel, chrome molybdenum, leaded brass, stainless steel, and many spring tempered materials. A clean cut that is free from rough edges or burrs is said to be obtained in cutting these materials. 83

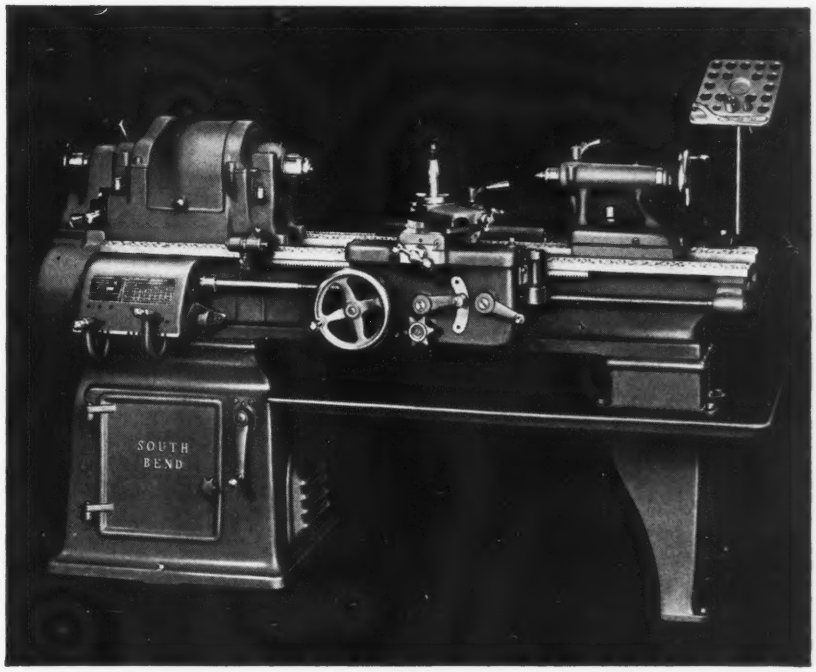


Fig. 1. South Bend 16-inch lathe with improved double-tumbler quick-change gear-box

South Bend Lathes Equipped with Quick-Change Gear of New Design

A new and simplified quick-change gear mechanism is being supplied on 16- and 14 1/2-inch swing lathes built by the South Bend Lathe Works, South Bend, Ind. This change-gear mechanism has a minimum number of parts, and being fitted with ball and needle bearings, requires less power and is much sturdier than previous designs.

A direct reading index chart shows the positions in which the two tumbler levers are placed for each of forty-eight screw thread pitches, forty-eight power longitudinal feeds, and forty-eight power cross feeds. There are no sliding clutches or sliding primary end gears to change. Shifting a single lever changes the feed instantly from coarse to fine for

High-speed continuous shearing machine brought out by the O'Neil-Irwin Mfg. Co.

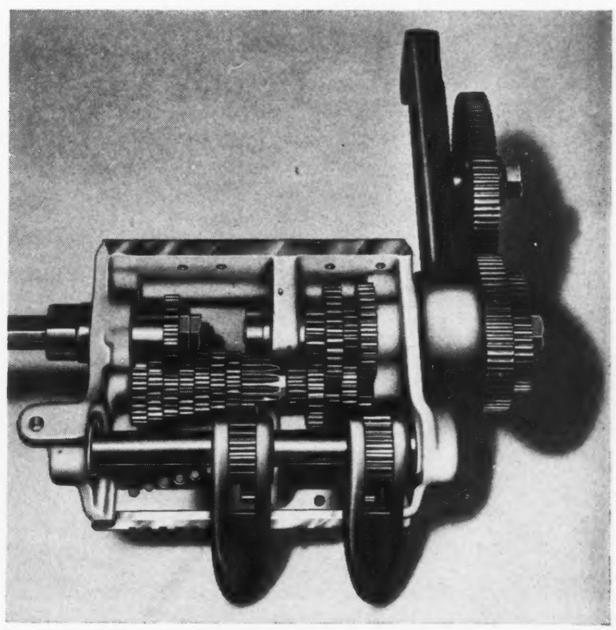


Fig. 2. Interior view of quick-change gear-box developed for South Bend lathes

To obtain additional information on equipment described here, use Inquiry Card on page 227.

obtaining either roughing or finishing cuts as required.

Standard screw threads from 8 to 224 per inch are obtained simply by shifting the two tumbler levers on the gear-box. The stud gear is changed for an additional series of coarse pitches ranging from 4 to 7 threads per inch. Provision is made for the use of special stud and intermediate gearing needed to cut metric screw threads, diametral pitch worm threads, or other special screw threads. The regular gear guards are so constructed that they will enclose the metric or other gearing, no additional guards being needed. A single oil reservoir lubricates the entire quick-change gear mechanism. 84

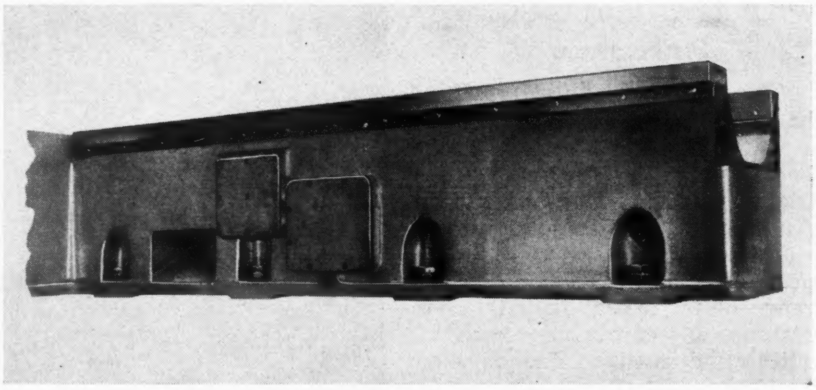


Fig. 2. Illustration showing improved method of mounting the new hardened ways on bed of Giddings & Lewis horizontal boring, drilling, and milling machine

Horizontal Boring Machines with Hardened and Ground Ways

The Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., has announced that heavy-duty surface hardened and ground ways are now available on the tables, saddles, columns, and runways of the horizontal boring, drilling, and milling machines built by the company. This special feature is designed to insure continuous machining accuracy over extended periods of time.

The new Giddings & Lewis method of hardening the ways, coupled with an improved means of mounting them, is claimed to offer two important advantages. First, the consistent, uniform hardness throughout the entire length of the ways insures unusually long wearing properties. This uniformity prevents galling, which often occurs when two bearing surfaces of similar hardness are in running or sliding contact. Second, the new mounting method minimizes the transmission of torque strains and stresses to the ways as a result of temperature changes. In addition, the way mounting tends to compensate for vibration created by near-by machines. All of the ways are precision fitted to their respective mounting surfaces and are held both flat and parallel throughout their entire length. 85

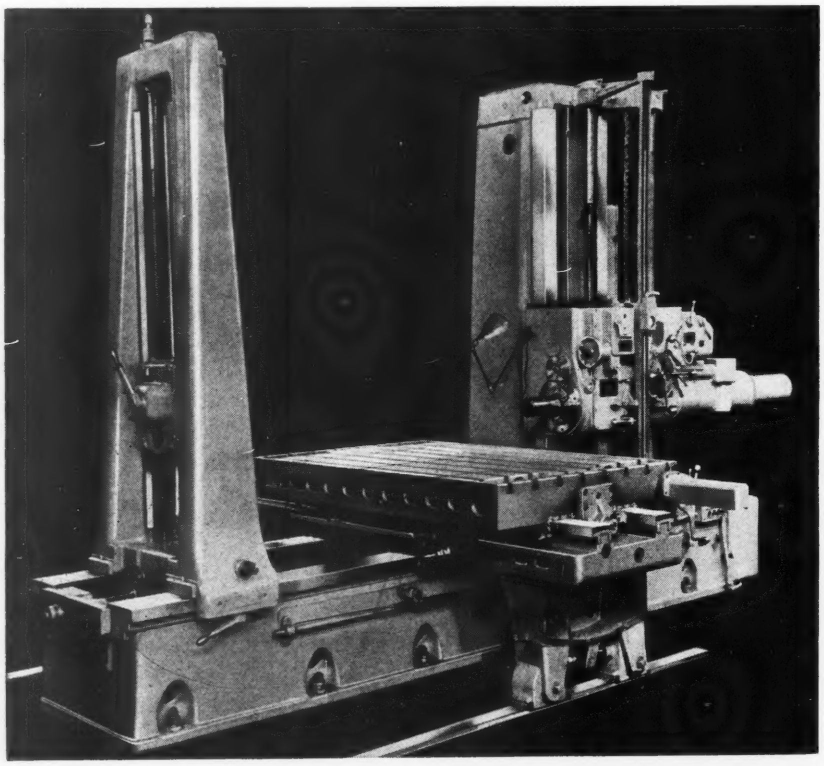


Fig. 1. Giddings & Lewis horizontal boring, drilling, and milling machine equipped with new hardened ways designed to provide lasting bearing surface and insure greater accuracy

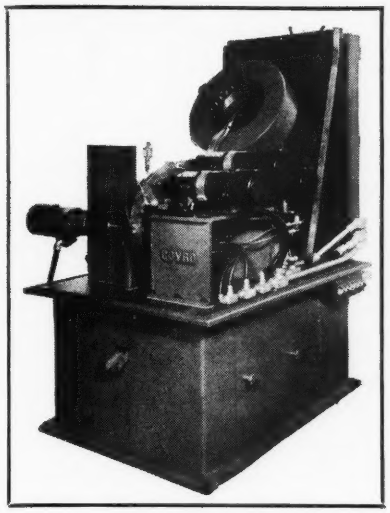
Automatic Drilling and Two-Way Countersinking Machine

Drilling and countersinking of cotter-pin holes in clevis pins and screws can be speeded up by the use of a machine recently placed on the market by the Govro-Nelson Co., Detroit, Mich. This machine performs the operations of drilling a hole and countersinking both sides at the rate of 1500 pieces per hour. It is fully automatic, employing four Model KH Govro-Nelson automatic drilling units, which operate simultaneously in conjunction with a Geneva type, eight-station indexing dial and a hopper part-feeding mechanism.

The part is first countersunk on one side by one of the drilling units. Two other units then accomplish the drilling in two stations, thereby reducing the drilling time per piece. Finally, the part is countersunk on the other side by the fourth drilling unit.

The machine is so designed that it will stop automatically should a tool break or a malformed part jam in the mechanism. It will also slow down automatically in case a tool becomes extremely dull. The indexing mechanism

To obtain additional information on equipment described here, use Inquiry Card on page 227.



Govro-Nelson automatic hopper-fed machine for drilling and countersinking cotter-pin holes in clevis pins

cannot operate unless all of the tools are out of the work. Similarly, the drilling units cannot operate during the indexing movement. 86

Federal Automatic Sorting Gage

The Federal Products Corporation, Providence, R. I., has added to its line a completely automatic gage designed for sorting bushings used in telephone lighting fuse units. The bushings handled on this machine are 1/2 inch in diameter by 3/4 inch long.

The over-all length of each piece is measured, after which it is automatically delivered to one of four work-boxes. Two of the boxes receive acceptable pieces of two classifications; the third receives any pieces that are over length; while the fourth receives pieces that are under length. The measuring and sorting of the bushings are handled at a production rate of approximately 3600 per hour.

Federal "Electricators" and a power unit are used to measure the bushings and control the segregating mechanism. Signal lights that can be seen at any point within the operating range keep the operator informed at all times regarding the functioning of the machine. 87

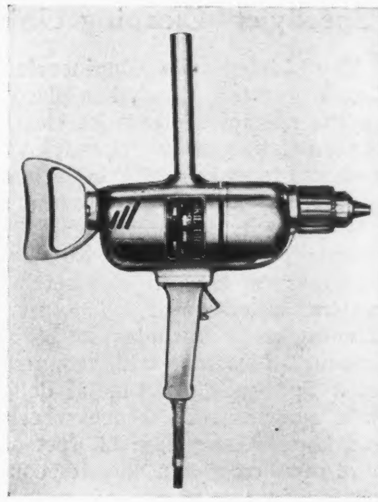
Federal gage for automatic measuring and segregating of small bushings into four classes according to lengths

New Large Size Redesigned Electric Drill

Four completely redesigned electric drills have just been introduced by Skilsaw, Inc., Chicago, Ill. The new drills, designated Models 283, 2101, 2103, and 2121, have a capacity for drilling holes from 1/2 to 3/4 inch in diameter in steel and up to 1 1/2 inches in diameter in hard wood.

These drills are designed to combine lightness, compactness, and balance in such a manner as to obtain the greatest accuracy and portability possible in the large portable drill class. Easy control and vibration-free performance tend to eliminate operator fatigue where these new improved portable tools are employed for continuous drilling.

The 1/2- and 5/8-inch models are heavy-duty, high-speed drills weighing not more than 14 1/2 pounds and measuring less than 16 1/8 inches in length. High-torque, low-speed models are available in 5/8- and 3/4-inch capacities, with comparable advantages in weight and length. The speed range of these heavy-duty and high-torque, low-speed models is from a low of 250 R.P.M., up to a high of 1000 R.P.M.



Large-size portable electric drill announced by Skilsaw, Inc.

All models have die-cast aluminum-alloy housings, over-size ball bearings, needle bearings, helical gears, and geared chucks. Morse taper sockets are available in place of the geared chucks. 88

To obtain additional information on equipment described here, use Inquiry Card on page 227.

"Speedyjet" Cleaning Unit

The Livingstone Engineering Co., Worcester, Mass., has placed on the market a steam-jet cleaning unit, known as "Speedyjet," designed to make available to companies who have a high-pressure steam supply of more than 80 pounds per square inch the advantages of the "Speedylectric" system of cleaning. The new cleaning unit includes a high-pressure detergent tank mounted on a light-weight all-metal dolly with rubber-tired 10-inch wheels and handle-bar grips; 25 feet of high-pressure steam hose for connection to the source of steam; and 25 feet each of steam and detergent hose from the tank to the "Speedylectric" steam lance.

In operation, the tank is filled with detergent or solvent and steam is admitted in the top of the tank to put the liquid under pressure. Detergent flows from the bottom of the tank through the detergent hose to the lance where it is atomized with the steam and directed at jet velocity, under finger-tip control of the operator against the object to be cleaned.

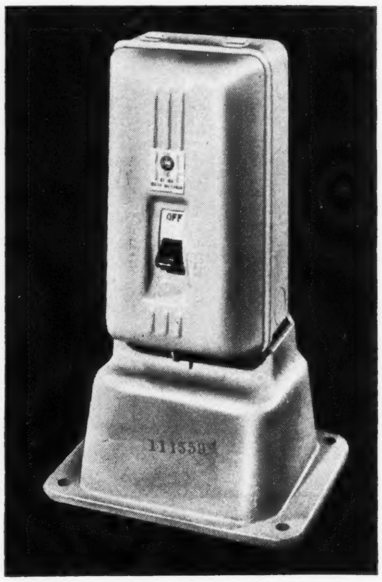
Solvent, detergent, or paint stripper can be applied either alone or mixed with steam in any desired proportion. This results in more rapid cleaning and effects substantial economies in the use of solvents or detergents.

Since the working area is never flooded, the unit can be used in factories for cleaning machinery and equipment during regular working hours without danger or annoyance to operators on adjacent machines. 89

Combination Drill and Power Hoist

Skilsaw Inc., Chicago, Ill., has announced a new combination tool that can be used both as a portable drill and a power hoist. The equipment consists of a 1-inch "Skil" drill and an American Handiwinch, which can be combined in a matter of minutes to produce a complete power hoist unit. A simple adapter kit that requires no special tools provides means for locking the drill and winch together.

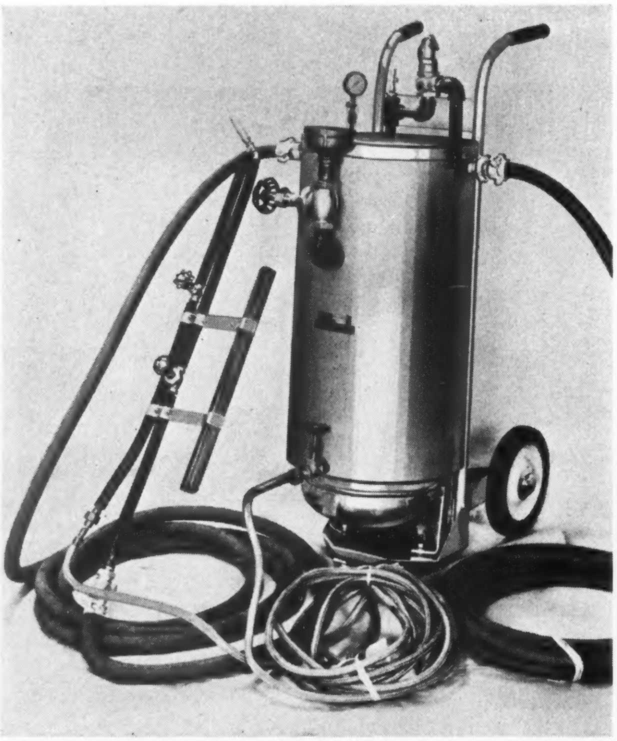
The drill can be easily taken out of the hoist bracket for use on any drilling job. It has an exceptionally powerful motor, is of sturdy construction throughout, and is especially adapted for all types of heavy maintenance and installation work. The hoisting capacity is 1000 pounds at a speed of 10 feet per minute......90



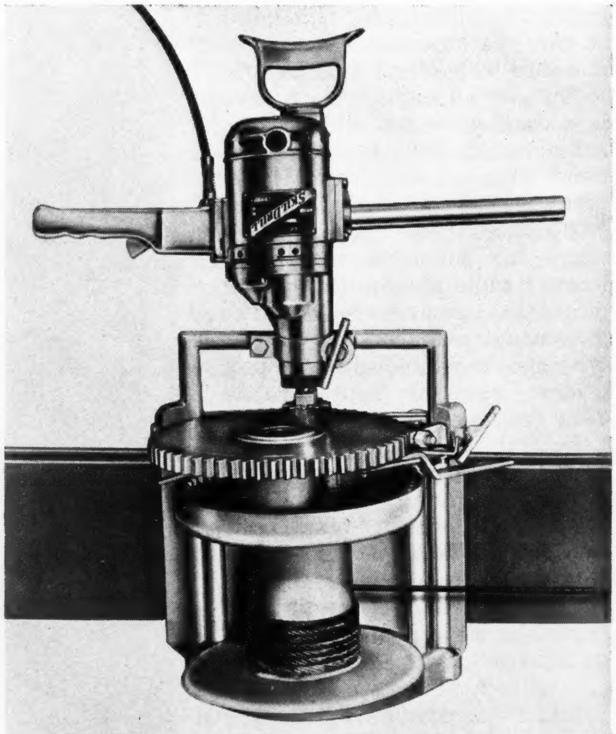
Westinghouse motor starter designed to protect operators and equipment

Westinghouse Motor Starter

A motor starter developed for the protection of operating personnel, as well as the machine equipment, is a new product of the Westinghouse Electric Corporation, Pittsburgh, Pa. The "Motor Watchman," as the equipment is called, is available in ratings up to 600 volts for 7 1/2-H.P.

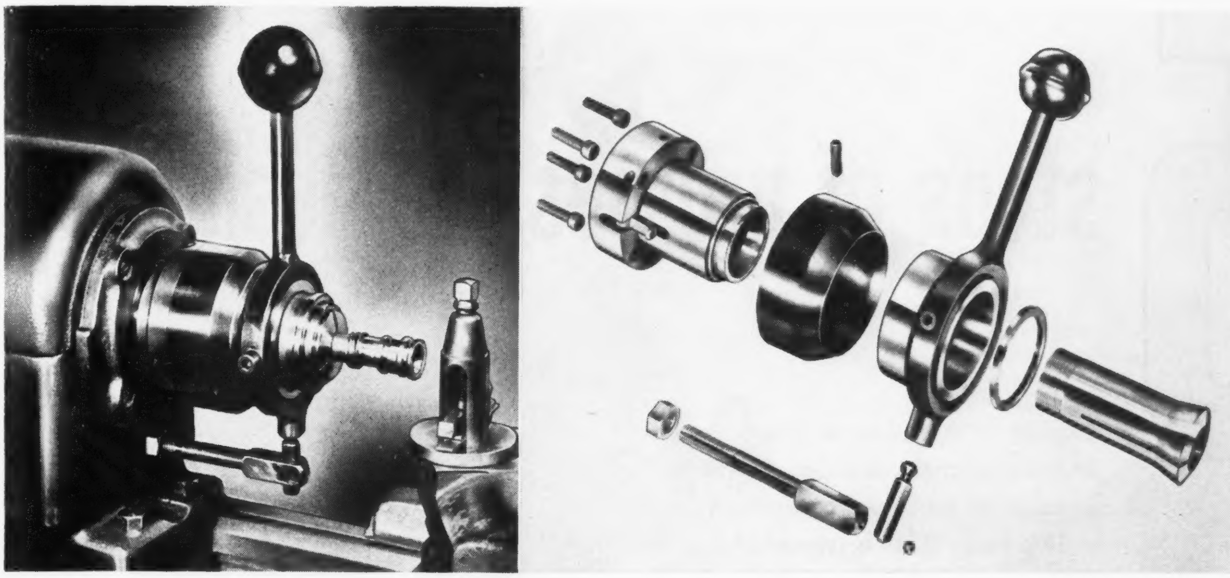


Steam-jet cleaning unit announced by the Livingstone Engineering Co.



Combination equipment consisting of a "Skil" drill and an American Handiwinch

To obtain additional information on equipment described here, use Inquiry Card on page 227.



"Davos" draw collet chuck brought out by the Stallion Mfg. Co.

polyphase motors and 5-H.P. single-phase motors; and up to 220 volts for 1 1/2-H.P. direct-current motors. It starts, stops, and provides overload protection for all three classes of motors.

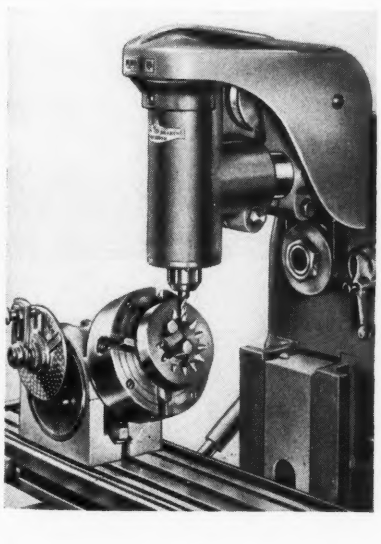
A self-indicating handle, an interlocked cover that prevents opening unless starter is "off," and a safety latch to lock starter "off" during servicing are features designed to protect the operators. Positive motor protection is provided by a quick make and break, over-center toggle mechanism and thermal overload relay. 91

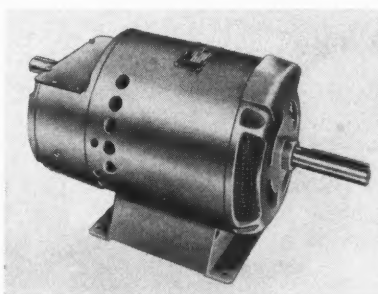
"Davos" Draw Collet Chuck

A draw collet chuck known as the "Davos," designed for turning, drilling, milling, grinding, deburring, polishing, and other second-operation jobs, has been brought out by the Stallion Mfg. Co., Chicago, Ill. Greater adaptability and accuracy, positive gripping action, ease of operation, and loading and unloading without stopping are advantages claimed for this chuck. It uses standard type draw collets, and is adaptable for use with special collets if number and make desired is specified. 92

New Vertical Milling Attachment

Improved, streamline, vertical milling attachment announced by Marvin Machine Products, Inc., Detroit, Mich. Outstanding features of this model are precision, ruggedness, versatility, and safety, provided by a protecting hood over the power transmission parts. ..93



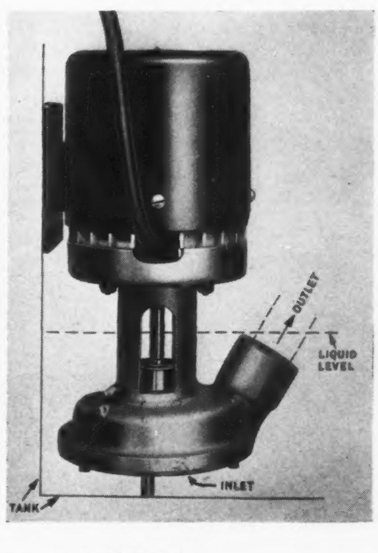


Reversing "Magneclutch" Transmission

Reversing "Magneclutch" transmission developed by Vickers Electric Division, Vickers Inc., St. Louis, Mo., for driving machine tools and other equipment. This "Magneclutch" has two driving members which rotate continuously in opposite directions. With this arrangement, a simple reversing drive is obtained, which can be remotely controlled by energizing the proper excitation coil. For machine tool applications, the gearing can be arranged to give a suitable cutting speed in one direction and a faster speed in the opposite direction for return travel. 94

Taco Coolant Pump

Small-size coolant and general-purpose pump brought out by Taco Heaters, Inc., Providence, R. I. Can be used as a refrigeration pump or water circulator and for other applications where it is desired to move water or soluble oils not under pressure. It has a bronze body, bracket, and impeller and a



To obtain additional information on equipment described here, use Inquiry Card on page 227.

5 steps of progressive design!

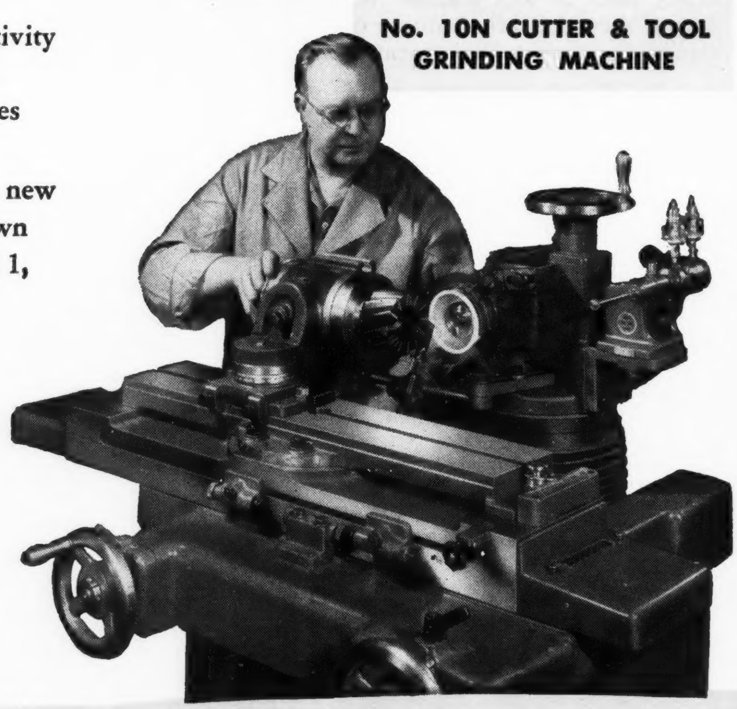
AUTOMATIC REVERSING VANE PUMPS

During 1950, Brown & Sharpe has announced the 5 new developments in machine tools and equipment shown here. This is typical of the major contributions which this company is constantly making to faster, lower-cost, more-accurate production for metal working plants.

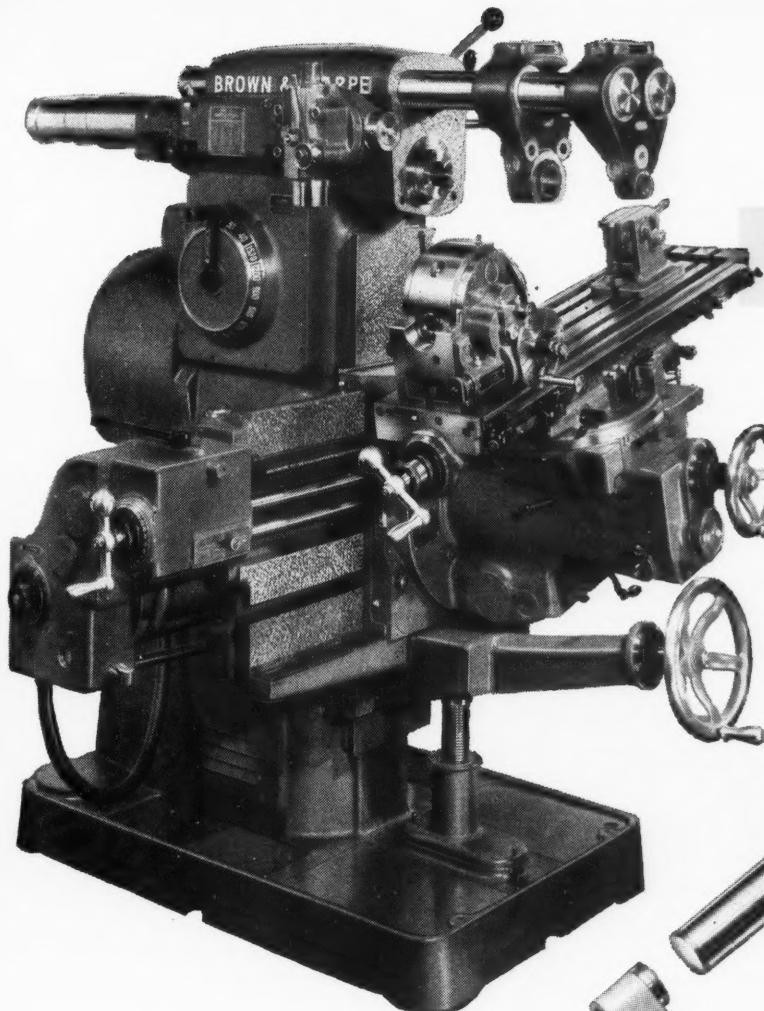
When you specify machine tools and equipment backed by such progressive engineering design, you are taking the soundest way to insure bigger returns on your investment . . . higher productivity for operators and machines . . . longer *accurate* life for machines and equipment.

Write for details on any of the new products illustrated here. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

No. 10N CUTTER & TOOL GRINDING MACHINE



Brown & Sharpe



NO. 0 OMNIVERSAL
MILLING MACHINE

COMPLETELY NEW LINE
OF MICROMETERS

OOL
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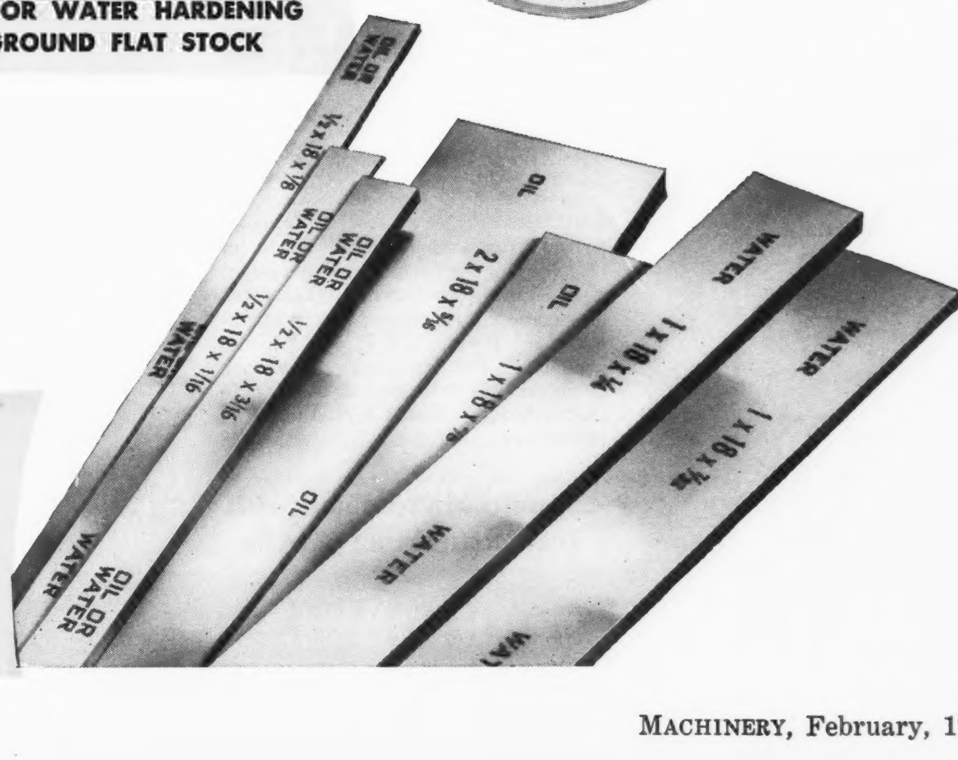
OIL OR WATER HARDENING
GROUND FLAT STOCK



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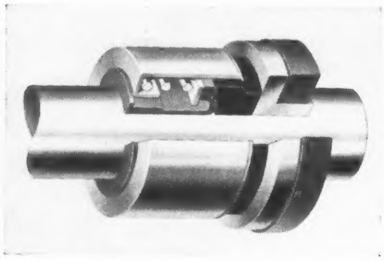
stainless-steel shaft. Equipped with filter screen at intake. Will pump 10 gallons per minute against a 3-foot head. Has a 1-inch hole in inlet plate located below water line, and an outlet machined for 3/4-inch National pipe thread. 95



Garlock Mechanical Seals for Rotary Shafts

One of a complete line of rotary seals for pump shafts or other rotating shafts, added to the line of the Garlock Packing Co., Palmyra, N. Y. Sealing is effected by leakless and positive contact between carefully lapped metal-to-carbon or metal-to-metal mating surfaces. One of these elements rotates with the shaft and the other is stationary. The stationary element does not contact the shaft, and thus there is no wear on the shaft. Built in several standard designs and in a wide range of materials to suit the service for which the seal is to be used. 96

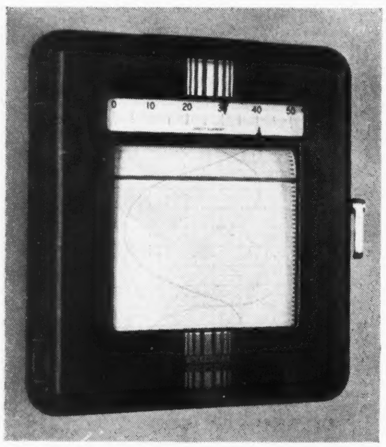
Heavy-Duty Electric Cable Hoists

One of a new line of heavy-duty electric cable hoists announced by the Cleveland Chain & Mfg. Co., Cleveland, Ohio. The hoists of this line are

manufactured in 1/2-, 1-, 1 1/2-, 2-, 3-, and 5-ton capacities, and will be sold under the trade name of "Bob-Cat." In addition to their availability through the Cleveland Chain & Mfg. Co., the hoists will also be distributed by other Round Associate Chain Companies. An outstanding feature of these hoists is the total enclosure of the motor within the cable drum, protecting it against moisture, corrosive atmospheres, etc. Designed for operation on 220-, 380-, 440-, or 550-volt three-phase, sixty-cycle current and available with either pendant rope control or push-button control on pendant cable. 97

Leeds & Northrup "Speedomax" Electronic Recorder

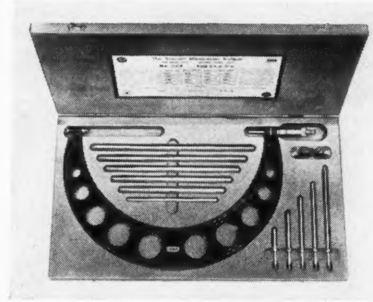
New two-pen "Speedomax" electronic recorder that records two functions simultaneously against time. The instrument is designed to save compila-



tion and point-by-point plotting of data. Since both functions are drawn as continuous curves on a 9 7/8-inch wide chart, swift changing variables can be easily followed. Circuits can be supplied to work with thermocouples, Thermohms, strain gages, tachometers, thermal converters, pH cells, and most other types of primary elements. The instrument can be used to operate either controls or alarms. Speed of response for full scale pen movement is 3 seconds, 2 seconds, or 1 second, as specified. Chart speed can be selected in the range of 1 to 1800 inches per hour. The instrument draws one curve in red ink, and the other in black. Made by Leeds & Northrup Co., Philadelphia, Pa. 98

Starrett Micrometer with Interchangeable Anvils

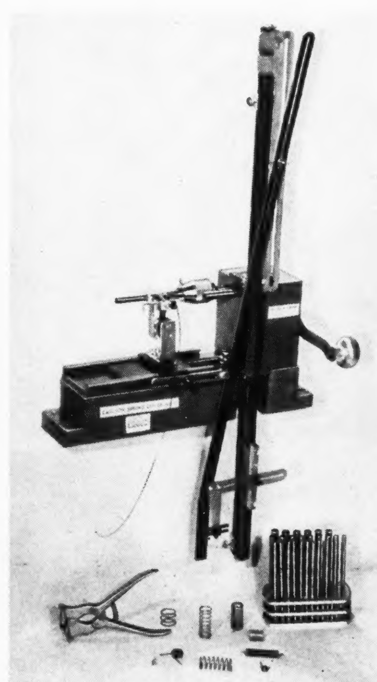
Micrometer that can be used for all measurements from 6 up to 12 inches by means of six interchangeable anvils. Each anvil is marked to show its size



range, and is fitted with an adjusting collar which compensates for wear and acts as a seat when clamped in position by a locking collar. Wrenches are furnished for making necessary adjustments. Features include one-piece spindle with threads hardened, stabilized, and ground from the solid and simple sleeve adjustment. A lock-nut maintains the setting of any reading. Also available in other ranges from 0 up to 24 inches. Product of the L. S. Starrett Co., Athol, Mass. 99

Hand-Operated Spring Coilers

New model hand-operated spring coiling machine for making compression, extension, and torsion springs, now available from the Carlson Co., New York City. This machine is especially useful for making experimental or sample springs and for small production runs up to lots of 500. The set-up time is usually less than five minutes, and about 300 precision springs can be wound per hour. Springs can be made with outside diameters up to 7/8 inch and over-all lengths up to 4 inches, using wire from 0.005 to 0.065 inch in diameter. 100



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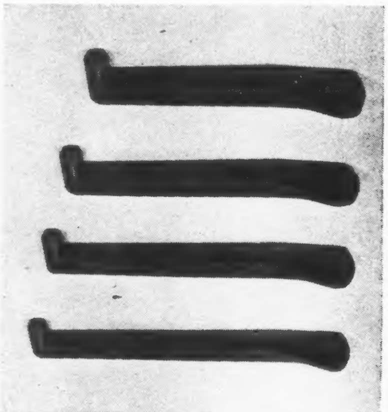
Trigger Stops for Progressive Dies

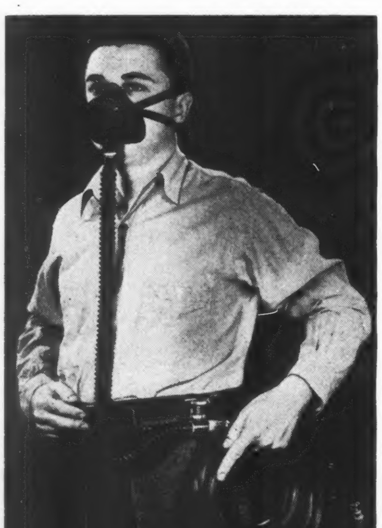
Standardized line of trigger stops for progressive dies, introduced by Reid Tool Supply Co., Muskegon Heights, Mich. These stops are made of cold-finished steel. They are available in 3 1/2-, 4-, 4 1/2-, and 5-inch lengths. The body is 5/16 inch square; the stop

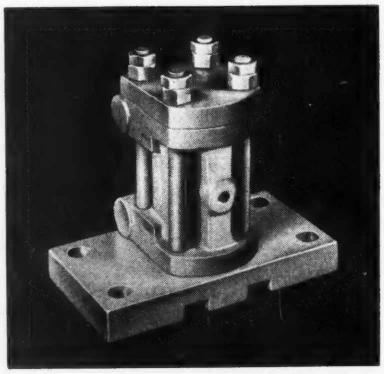


end has a 5/32-inch radius and is 5/8 inch long. The finger end is forged flat. The stops are not hardened and can be readily drilled. 101

Air-Line Respirator

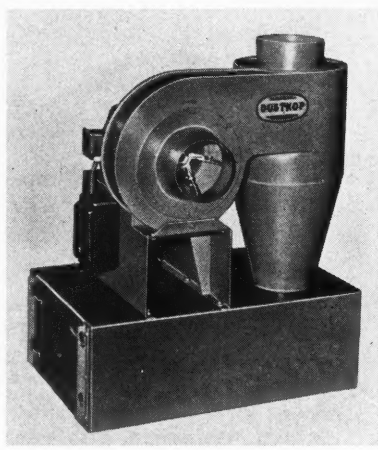
Air-line respirator No. 2099 made by American Optical Co., Southbridge, Mass. Recommended for use when performing such operations as paint spraying, welding, abrasive blasting, etc. Protects against dust, fumes, vapors, mist, smoke, and gases. No filters or cartridges are needed because a continuous flow of fresh air is directed through the hose. Air flow to facepiece is regulated by adjustable valve clipped to worker's belt. Designed to operate at air-line pressure between 9 and 25 pounds per square inch. 102





"Quiet Type" Bin and Hopper Vibrator

"Quiet Type" vibrator (Style EM), designed specially for use on bins, hoppers, chutes, shake-outs, and similar equipment. Employs heavier pistons and longer strokes than can be used on heavy-duty impact type vibrators without danger of breakage. There is said to be no impact of the piston on either end and no metal-to-metal pounding or loud noise. Made in 1 5/8- to 4-inch sizes. Announced by the Cannon Vibrator Co., Cleveland, Ohio. 103

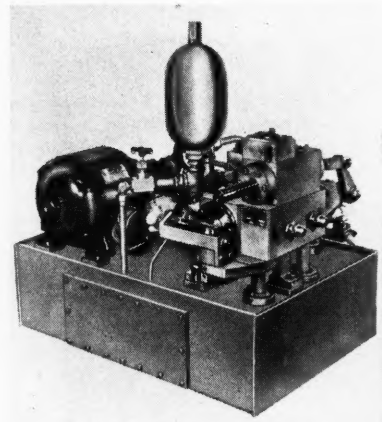


"Dustkop" Filterless Dust Collector

Filterless dust collector recently added to the "Dustkop" line manufactured by the Aget-Detroit Co., Ann Arbor, Mich. This Model 8N50 dust collector, rated at 885 cubic feet per minute with a 3-inch static suction, exhausts cleaned air outdoors, thus eliminating recirculation of toxic fumes and vapors. The paddle wheel type fan is driven by a 3/4-H.P. continuous-duty motor. It is applicable for removing dust from grinding or polishing wheels and from multiple abrasive or sanding belts. It is also capable of clearing lint and string from buffing operations, as well as chips, shavings, and sawdust from woodworking machines. The unit is portable and can be quickly installed. It requires a floor space of only 20 by 30 inches. 104

Control for Hydraulic Flash-Welding

Control known as "Hydra-Flash," developed for use with any make of flash-welder having a transfer capacity up to 500 KVA. This fully hydraulic unit, with calibrated adjustments, facilitates duplication of set-ups. The control enables any material that is practical to



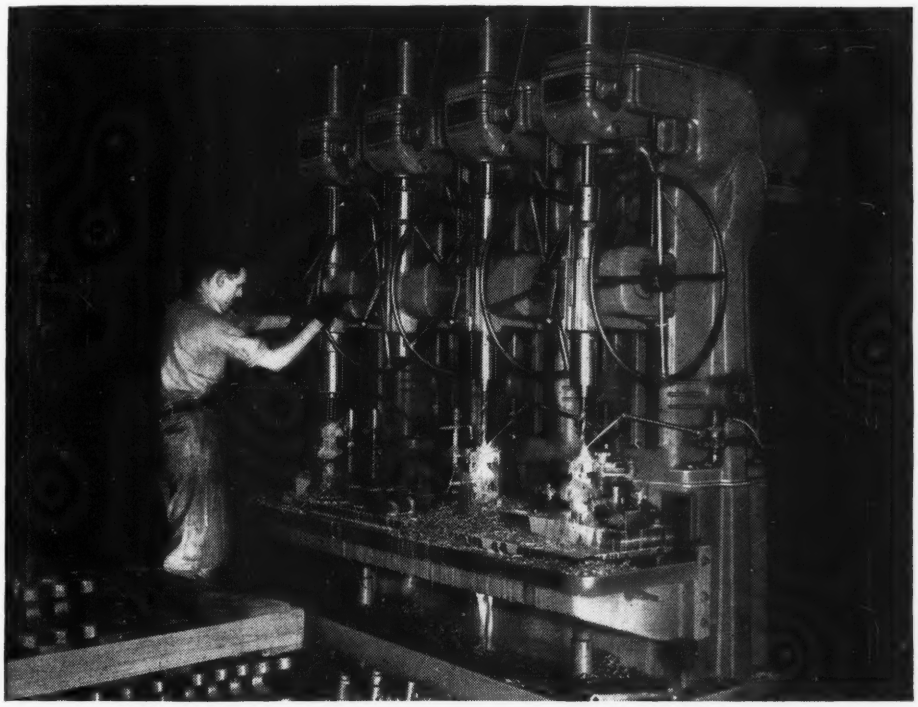
flash-weld to be welded in any cross-sectional area within the physical and electrical capacities of the machine. It has been especially designed for the conversion of mechanically driven flash-welders to hydraulic operation. Announced by Kingsley A. Doutt, Detroit, Mich. 105

Marquette Alternating-Current Arc-Welder

One of a new 80 series of industrial alternating-current arc-welders brought out by the Marquette Mfg. Co., Minneapolis, Minn. These welders are available in three sizes—200-, 300-, and 400-ampere capacities—and are designed for heavy-duty, continuous production welding. An important fea-

To obtain additional information on equipment described here, use Inquiry Card on page 227.

Higher *Production*
Lower *Costs*



Fifty-three minutes are saved in the time for drilling on **each** of the brake tongs that are being manufactured at the Red Lion plant of The Budd Company. The brake tong is a part of the disc brake assembly, and involves 1-1/8", 1-1/16" and 1-7/16" diameter drilling in tough steel. These parts are produced in sufficient quantities to warrant the use of the simplified production type four-spindle gang drill. Each unit of this machine is powered by a 7½ HP driving motor, and one operator can keep all four units performing at peak capacity.

If your work includes mass production drilling, this is the type of machine you will want to know about. Its husky design and many features for convenient, fast and dependable operation, will interest you. Single units as well as gang drills are available in 21", 24" and 28" sizes, and with 3, 5, 7½ or 10 HP motors. These powerful DIRECT DRIVE Super Service machines are especially adapted to utilize drill heads.

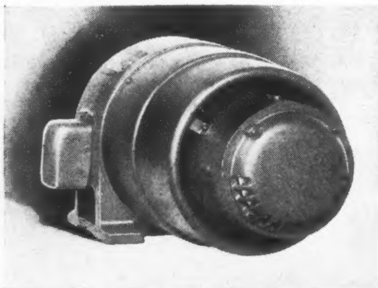
Investigate the time saving possibilities by writing today for Booklet U-27.

THE CINCINNATI BICKFORD TOOL CO.
RADIAL AND UPRIGHT — SUPER C.B. SERVICE — DRILLING MACHINES

Radials 7½" dia. col., 2½' arm, to 26" dia. col., 12' arm.
General purpose Uprights, 21" to 28" sizes.
Production Uprights, 21" to 28"
Jig Borers, Portable Horizontals, Spacing Table Machines.

THE CINCINNATI BICKFORD TOOL CO. Cincinnati 9, Ohio U.S.A.

ture is the use of "Hipersil" steel transformer cores, which provide one-third greater flux-carrying capacity, thus reducing power consumption and operating costs. 106

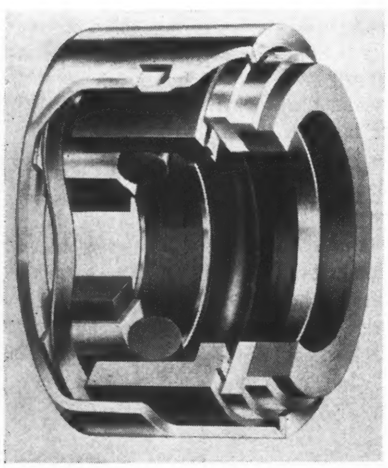


Synchronous Generator

"Tri-Clad" high-speed synchronous generator — one of a complete line now made by the General Electric Co., Schenectady, N. Y., in KVA ratings of from 1.875 to 1250. The new generators recently added to the line are available in four basic designs, having ratings from 1.875 to 50 KVA, 60 and 400 cycles. 107

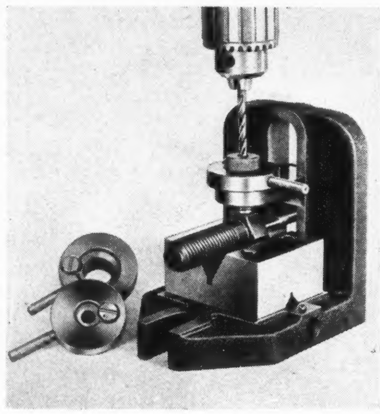
Pump Shaft Seals

Broken sectional view showing application of balanced-pressure seals developed to meet the needs of pump manufacturers by the Sealol Corporation, Providence, R. I. These seals are supplied complete in one package, factory assembled and tested. Their construction eliminates the possibility of lost or damaged parts, faulty assembly, or contamination of the precision-lapped seal faces. No special machining on the part of the pump manufacturer is required. Rubber friction members incorporated in the rotating and stationary elements of the seals provide the proper driving and holding actions. The seals are built of corrosion-resistant materials. They are available for shaft sizes from 3/8 inch to 1 1/2 inches. 108



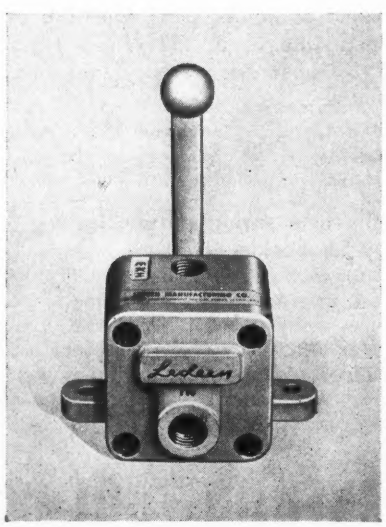
Mathewson Drill Jig

Adjustable drill jig designed especially to reduce lay-out and drilling time on small-lot jobs. Can be used for drilling holes through round stock from 1/4 inch to 2 inches in diameter and hexagonal stock and cap-screws from 1/4 to 1 inch in size. Hole diameters range from 1/16 to 1/2 inch, using standard slip bushings. The hardened V-block has a 90-degree vee for round stock on one face, and a 60-degree vee for hexagonal stock and cap-screws on the opposite face. Adjustable stops are provided to locate the work longitudinally at any distance from the end. Made by the Mathewson Machine Works, Inc., North Quincy, Mass. 109



Air or Hydraulic Valves

One of a line of valves for actuating air or hydraulic cylinders just introduced by the Ledeen Mfg. Co., Los Angeles, Calif. These valves embody the rotating disk construction, and are made in three types for hand, foot, and finger or solenoid operation. They are available in fourteen models for five different cycles and in six sizes. Can be used for controlling the flow of air, oil, or water. 110



Coming Events

MARCH 15-17—Annual meeting of the American Society of Tool Engineers at the Hotel New Yorker in New York City. Executive secretary, Harry E. Conrad, 10700 Puritan Ave., Detroit 21, Mich.

MARCH 19-23 — Seventh WESTERN METAL EXPOSITION AND CONGRESS in the Auditorium and Exposition Hall in Oakland, Calif. Sponsored by the American Society for Metals, in cooperation with twenty other national technical societies. Secretary, William H. Eisenman, Exposition Hall, 918 Fallon St., Oakland 7, Calif.

MARCH 19-23—CONFERENCE ON INDUSTRIAL PERSONNEL at Columbia University, New York City. Further information and registration procedure can be obtained by addressing David N. Edwards, Instructor in Industrial Engineering, Columbia University, New York 27, N. Y.

APRIL 16-18—National convention of the AMERICAN SOCIETY OF LUBRICATION ENGINEERS at the Bellevue-Stratford Hotel in Philadelphia, Pa. National secretary, W. F. Leonard, 343 S. Dearborn St., Chicago 4, Ill.

APRIL 17-20—TWENTIETH NATIONAL PACKAGING EXPOSITION sponsored by the AMERICAN MANAGEMENT ASSOCIATION at the Auditorium in Atlantic City, N. J. Public relations director, Edward K. Moss, 330 W. 42nd St., New York 18, N. Y.

APRIL 23-26—Fifty-fifth annual convention of AMERICAN FOUNDRYMEN'S SOCIETY in Buffalo, N. Y. Secretary-treasurer, William W. Maloney, 616 S. Michigan Ave., Chicago 5, Ill.

APRIL 30-MAY 4—FOURTH NATIONAL MATERIALS-HANDLING EXPOSITION in the International Amphitheatre, Chicago, Ill. Sponsored by the Materials Handling Institute. Further information can be obtained from the exposition management, Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

APRIL 30-MAY 11—BRITISH INDUSTRIES FAIR in Birmingham and London, England. Further information can be obtained from British Information Services, 30 Rockefeller Plaza, New York 20, N. Y.

MAY 23-24—Fifth annual convention of the AMERICAN SOCIETY FOR QUALITY CONTROL in Cleveland, Ohio; headquarters, Hotel Cleveland. For further information, address John F. Occasione, Publicity Chairman, American Society for Quality Control, care of American Steel & Wire Co., 1406 Rockefeller Bldg., Cleveland 13, Ohio.

To obtain additional information on equipment described here, use Inquiry Card on page 227.

By E. S. Salichs

BETWEEN GRINDS

Smoke Laid Low

Stainless steel sheet was used in making a horizontal smokestack, since to erect one company's new smokestack in the usual direction (up, Ed.), the smoke would have curled into the windows of a higher structure. Now the smoke detours to its goal, i.e., windows no doubt.

Do It YourZelf

According to an article "Haven for Inventors" in January *Steelways*, professional free-lance machinists, inventors, and amateurs burning with ideas are welcomed alike at the Zelf Tool & Die Works in New York City, probably the world's only "make-it-yourself" machine shop where complex machine tools can be rented for 25 cents to $2 an hour. Proprietor Xelphin Dugal (Zelf to his customers) provides several engine lathes, millers, a metal cutting planer, surface and cylindrical grinders, a pantograph engraver, drill presses, buffers, band saws, welding equipment and hand tools. The article describing this ingenious, friendly-atmosphere shop gives some case histories, as of a gal artist who designed and built, it is true with neighborly help, a "skyscraper silhouette" lamp which sold most profitably; and of a client who grossed $40,000 in a single year and now has his own telephone installed in the shop. While there are some "left and not called for" items which discouraged inventors have forsaken, on the whole the bulk of Zelf's business comes from trained machinists who are making capital of the opportunity—and earning it.

Shooting from the Stars

Cartographic camera in a jet plane recently snapped a picture at an exact height of 50,899 feet (8 1/2 nautical miles), believed to be the highest photograph ever made from a single-place military aircraft. Taken close to Washington, D. C., it is possible to spot interesting landmarks in the picture. Some photographers do better vertically from afar than we can horizontally at eight paces.

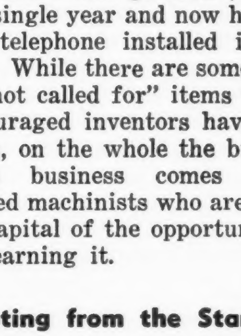
And the Mules are Bumper to Bumper

Automobile Facts quotes a letter received by an automobile company from an enterprising Indonesian: "Do you like to place an advertisement on top of the most famous mountain of Indonesia: the Keli Mutu, with its three lakes, red, blue, and green? Every traveler who visits the Island Flores wants to go to the top of it. I hire the place from the King of Mio. It will be the first auto advertisement on its top." Can you arrange for floodlights on the billboard, too?

Pixies' Paradise

We read recently that your television receiver contains 14,370 feet of wire, 799 individual parts, 756 soldered joints, and requires 7458 assembly operations. By a flick of the wrist, it all turns into a cowboy.

ALL CLEAR—when you read the article on tank manufacture in a British plant, March MACHINERY.



WHIRLING WOODHOUSE — Born in England, Harold Woodhouse began his career in the drafting office of an English turbine company, Fraser & Chalmers, before coming to the United States in 1926. From then until 1945, he was with the DeLaval Steam Turbine Co., and affiliated company Turbo Engineering Corporation, on turbine design development. Starting in the late '30's, he was associated in the development of the turbosupercharger, based on the use of the well-known Birmann mixed flow compressor impellers, later specializing on this type of turbine and impeller design. From 1945 to 1947, Mr. Woodhouse was director of engineering of the Stratos Division of Fairchild Aircraft which concerns itself with the design and manufacture of high speed aircraft air conditioning and pressurizing units. Since then, Mr. Woodhouse, a resident of Morrisville, Pa., has been general manager and chief engineer of Power Generators Ltd., supervising the design of high speed, high pressure turbine driven pumps for marine use but to aircraft standards. Commenting on his article which appears on page 152, Mr. Woodhouse says: "This deals with an unusual generating operations. These (Birmann), and similar impellers, are the subjects of much production activity at present, but little has so far been published about them. . . . While the early development of Birmann impellers took place at DeLaval, the quantity production was handled by a subsidiary, Turbo Engineering Corporation, which went out of existence at the end of the war. Some of the work they were doing is being carried on by Thompson Products; other people—such as Ranger Engines—are making variations of the impeller.

News of the Industry

California

MACHINERY MFG. CO., builder of the Vernon line of jig borers, millers, shapers, and tool and cutter grinders, has announced a reorganization of the company under the name DIVERSIFIED METAL PRODUCTS CO., with manufacturing facilities at 5125 Alcoa Ave., Los Angeles 58, Calif. Administrative personnel of the new company will remain the same.

Illinois

CHARLES L. HARDY was elected president of Joseph T. Ryerson & Son, Inc., Chicago, Ill., at a recent meeting of the board of directors. Mr. Hardy takes the place of EVERETT D. GRAFF, who has become chairman of the executive committee. At the same meeting THOMAS Z. HAYWARD was elected vice-president in charge of sales. Both Messrs. Hardy and Hayward have been made directors and members of the executive committee. Mr. Hardy was formerly assistant to the president, and Mr. Hayward was general manager of sales for the entire group of Ryerson steel service plants.

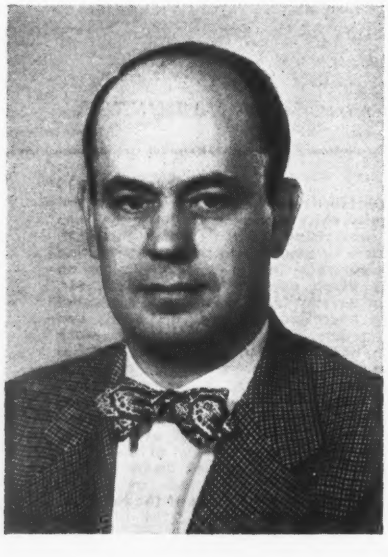
KENNETH M. ALLEN has been elected a director of the Rockford Machine Tool Co., Rockford, Ill., manufacturer of hydraulic shapers, planers, slotters, and "Economy" lathes. Mr. Allen has been with the company since 1935, and will continue to serve in his present position as sales manager.

(Left) Charles L. Hardy, newly elected president of Joseph T. Ryerson & Son, Inc. (Right) Thomas Z. Hayward, vice-president in charge of sales

NORMAN C. MINEHART has been elected vice-president in charge of the Abrasive Division of Charles H. Besly & Co., Chicago, Ill., manufacturers of abrasive wheels, grinders, taps, and reamers. Also announced is the appointment of JACK T. LEBEAU as manager of the abrasive department. Both men will make their headquarters at the general office of the company, 118 N. Clinton St., Chicago.

PAUL J. LARSEN, former director of the Office of Civil Defense of the National Security Resources Board, has been appointed assistant to the president of the Borg-Warner Corporation, Chicago, Ill.

(Above) Norman C. Minehart, new vice-president in charge of Abrasive Division of Charles H. Besly & Co.



(Left) Kenneth M. Allen, newly elected director of the Rockford Machine Tool Co.

(Right) Paul J. Larsen, recently appointed assistant to the president of the Borg-Warner Corporation

Harris & Ewing

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LINK-BELT Co., Chicago, Ill., announces that its South African subsidiary—Link-Belt Africa Ltd.—has purchased a 12,000 square foot plant on a twelve-acre plot in Springs, Transvaal, about twenty-eight miles from Johannesburg, for the purpose of manufacturing conveyor machinery and other Link-Belt products.

D. A. PAISLEY has been appointed technical sales representative of the Atlas Chain & Mfg. Co., Philadelphia, Pa., with headquarters at 570 Randolph St., Chicago, Ill.

Indiana

NATIONAL TUBE Co., United States Steel subsidiary, Gary, Ind., has announced that a large extrusion plant for the manufacture of high-alloy seamless specialty tubes, as well as shapes and bars, will be installed at the Gary, Ind., Works of the company. The application of the extrusion process on a commercial basis to the manufacture of seamless steel tubes is an innovation in this country. The facilities, which will be housed in an existing building at the plant, will consist of a 2500-ton hydraulic extrusion press and related equipment for the production of tubes ranging from 1 1/2 inches to 6 1/2 inches in diameter, with wall thicknesses up to 1/4 inch and lengths up to 60 feet.

WESTINGHOUSE ELECTRIC CORPORATION has made plans to build a new plant for the production of small electric motors in Union City, Ind., which is expected to be completed at the end of the year. When in full operation, the plant will employ approximately 500 men and women. RALPH E. DAVIS, previously plant superintendent at the small motor plant at Bellefontaine, Ohio, will have charge of the new plant.

Michigan and Minnesota

PONTIAC MOTOR DIVISION, GENERAL MOTORS CORPORATION, Pontiac, Mich., announces the following promotions: E. R. PETTENGILL has been made administrative assistant to the general manager; BUEL E. STARR, general manufacturing manager; A. F. JOHNSON, manufacturing manager; J. P. CHARLES, assistant chief engineer; CHARLES O. JOHNSON, general plant superintendent; and GEORGE GUINN, axle plant superintendent.

CROBALT, INC., manufacturer of nonferrous cast-alloy cutting tools and wear-resistant alloys, has recently built and moved into a larger plant on a one-acre tract at 2800 S. State St., Ann Arbor, Mich. This is the first of several units to be erected.

MAHLON M. MATCHETT has been appointed sales engineer for the Illinois Tool Works, Chicago, Ill. He will be associated with the company's Tool and Machine Division, and will make his headquarters at the Detroit office.

FRANK HALLBERG has been made chief engineer of the Ross Operating Valve Co., Detroit, Mich. He was previously connected with the Clinton Machine Co. of Clinton, Mich.

ROBERT J. HAUSE has been made sales representative in Minnesota and adjacent territory for the L. S. Starrett Co., Athol, Mass. His headquarters will be at Minneapolis. Mr. Hause was previously at Chicago.

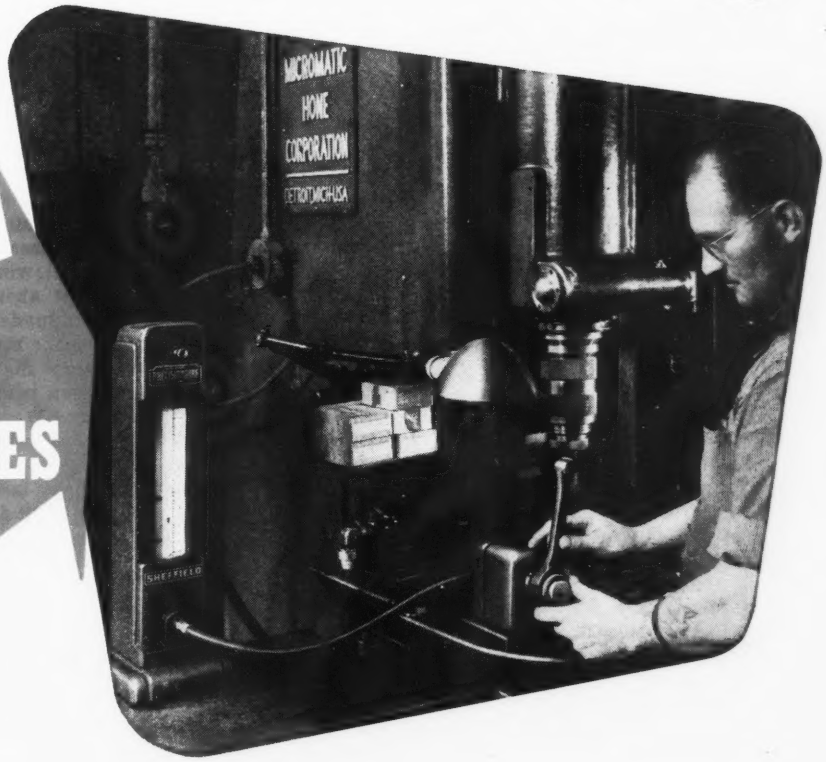
New England

C. G. BIGWOOD has been appointed vice-president in charge of operations of the L. S. Starrett Co., Athol, Mass. Other appointments made include W. A. THORP, works manager; R. E. Starrett, W. P. METEVIA, and F. G. WHITE, superintendents; and D. R. STARRETT, chief methods engineer.

(Top View—Left to Right) C. G. Bigwood, W. A. Thorp, and R. E. Starrett
(Bottom View—Left to Right) W. P. Metevia, F. G. White, and D. R. Starrett

Management Gratified with Higher Quality and Lower Costs

Resulting from use of SHEFFIELD PRECISIONAIRES



Today's Hydra-Glide Motorcycles represent the best values ever offered by Harley-Davidson Motor Co., Milwaukee. They are the result of gaging and manufacturing methods which earned special grateful acknowledgment from top management to Inspection and Production personnel for higher quality at substantial cost savings.

The combined use of statistical quality control and Sheffield Precisionaires at the machines has eliminated selective assembly and final bench inspection at Harley-Davidson.

Savings are most worthwhile, including reduced work-in-process inventory and lower cost of storage and material handling.

Precisionaires, also, have helped operators get improved performance from their machines—fewer rejects, more acceptable parts.

"Scrap and costly rework have been practically eliminated wherever we have installed Precisionaires", say Harley-Davidson key manufacturing executives.

Precisionaires are used on connecting rod, piston pin, cylinder, tappet guide and all transmission gear bores.

Our "Customer Consulting Service" will gladly send you Precisionaire application data.

5682

the Sheffield corporation
Dayton 1, Ohio, U. S. A.

GAGES • MEASURING INSTRUMENTS • MACHINE TOOLS • CONTRACT SERVICES • THREADING TOOLS

Earl C. Hughes, recently re-elected president of the Grinding Wheel Institute

EARL C. HUGHES, vice-president of the Bay State Abrasive Products Co., Westboro, Mass., was re-elected president of the Grinding Wheel Institute at the annual meeting in Buffalo last November. In addition to filling the position of vice-president of the Bay State Abrasive Products Co., Mr. Hughes also serves as executive secretary of the company, a post he has held since he joined the concern in 1936.

F. C. HELMS, JR., has been appointed midwest branch manager of the Morse Twist Drill & Machine Co., New Bedford, Mass., a division of the Van Norman Co., Springfield, Mass. He will make his headquarters at the Morse new Chicago office, 571 W. Randolph St. Mr. Helms succeeds CHARLES F. MYERS, who was recently appointed sales manager, with headquarters at New Bedford. Also announced is the appointment of NORMAN S. FAGERSON as representative in the Chicago area, succeeding M. P. LANSING, who has been transferred to the Texas territory.

OTTO HECHT has been named production manager of the Laminated Shim Co., Inc., Glenbrook, Conn., manufacturer of general stampings, shim stock, and lock-nuts. He has been affiliated with the company for sixteen years. Prior to his present appointment he held the position of methods engineer.

FLEXIBLE TUBING CORPORATION has recently moved from Branford, Conn., into a new plant at Guilford, Conn., which will increase the production capacity of the company threefold.

CONNECTICUT ENGINEERING INSTITUTE announces a change in name to STATE TECHNICAL INSTITUTE and also removal to new quarters at 541-561 Main St., Hartford, Conn.

EVAN PRICE has been made turbine sales manager of the Whiton Machine Co., New London, Conn. He was formerly in charge of turbine sales for the Kissick Co. of New York.

EARL P. LEEDS and JAMES MEEHAN, who have been connected with the sales department of the Brown & Sharpe Mfg. Co. at the home office in Providence, R. I., have been appointed sales directors.

New Jersey

RAYBESTOS-MANHATTAN, INC., Manhattan Rubber Division, Passaic, N. J., announces the following changes in personnel brought about by the death of Harry V. Snyder, factory manager: R. J. GORECKI succeeds Mr. Snyder as factory manager; W. E. PERKINS has been made assistant factory manager; D. J. FENELON becomes director of labor relations, and R. GRIFFITH personnel manager; J. FREELAND has been named manager of the cord belt department, and A. P. SNYDER superintendent of the same department.

CIRCO PRODUCTS CO., Cleveland, Ohio, manufacturer of vapor degreasers, metal cleaning products, and solvents, has sold all manufacturing and sales rights to these products to the OPTIMUS EQUIPMENT CO., Matawan, N. J. The main sales and purchasing offices, as well as all manufacturing activities, will be transferred immediately to the Matawan plant.

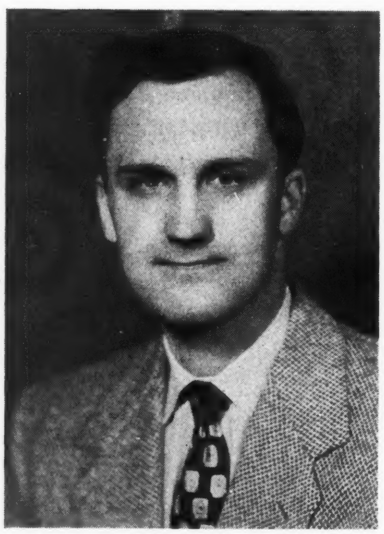
CHARLES EISLER, president of the Eisler Engineering Co., Inc., Newark, N. J., was recently given the honorary degree of Doctor of Science by Bloomfield College and Seminary, Bloomfield, N. J., for his "outstanding achievements in the incandescent lamp and radio-tube industries."

JOHN A. BUKOWSKI has been made general superintendent of the Atlas Foundry Co. and the Atlas Stainless Steel Co., of Irvington, N. J. Mr. Bukowski was formerly works metallurgist with the Worthington Pump Co., Harrison, N. J.

BENNETT MACHINERY CO. announces that it has removed its offices from the Hudson Terminal Building in New York, where they have been located for the last thirty-five years, to its plant and warehouse in Clifton, N. J.

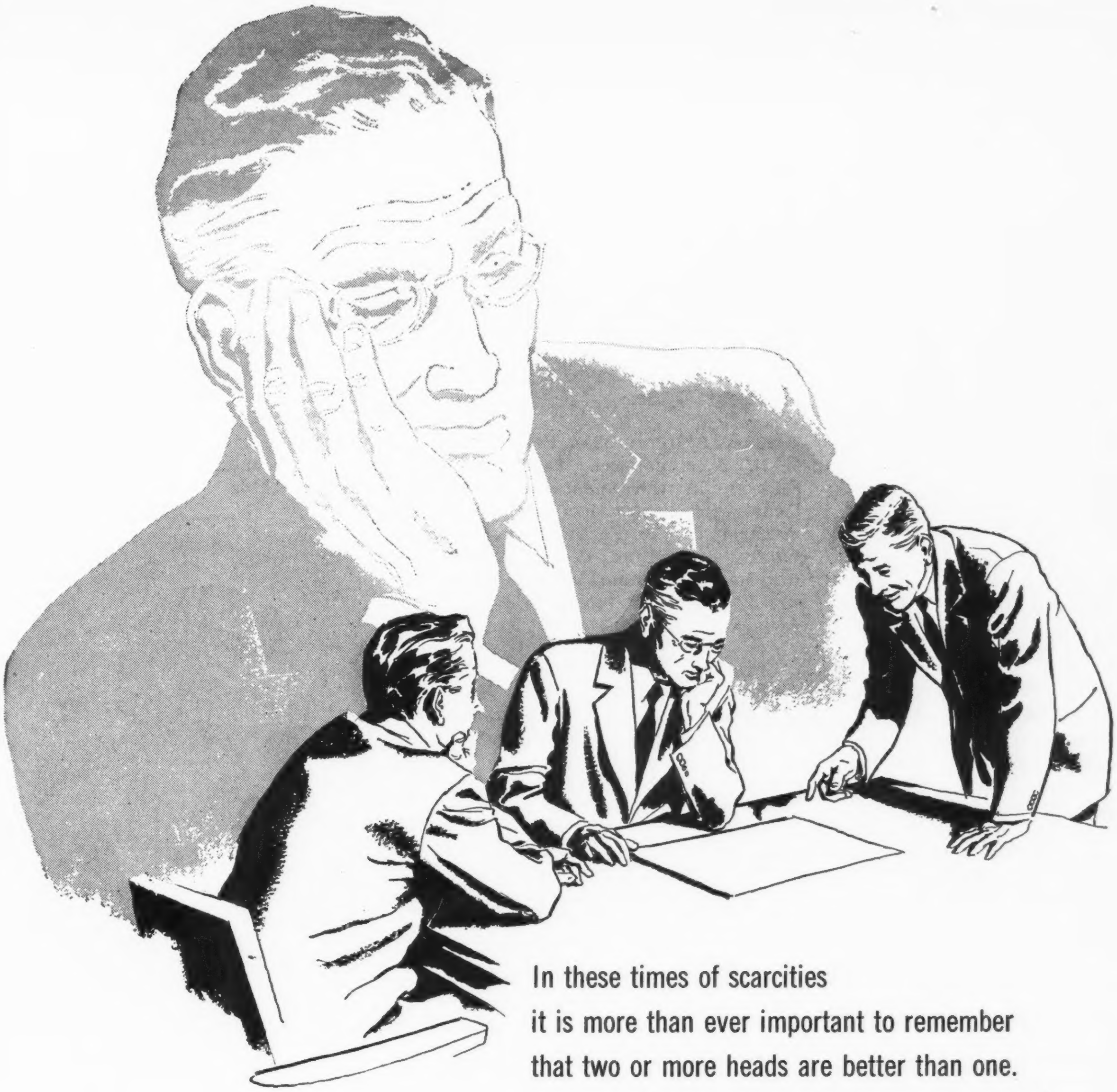
New York

RALPH J. CORDINER has been elected president of the General Electric Co., Schenectady, N. Y., to succeed CHARLES E. WILSON, who has become chairman of the new Defense Mobilization Board. Mr. Cordiner, who has been associated with the company for twenty-four years, has served as manager of five of the company's departments, and has been executive vice-president and a director of the company since 1949. Mr. Wilson, the retiring president, completed fifty-one years of continuous service with the General Electric Co. in November. Starting as a messenger boy with the Sprague Electric Co. in 1899, which later became a part of the General Electric Co., he rose to the presidency in 1939. He served as vice-chairman of the War Production Board from 1942 to 1943, and then became executive vice-chairman with authority over all war production.



Otto Hecht, recently named production manager of the Laminated Shim Co., Inc.

Ralph J. Cordiner, newly elected president of the General Electric Co.



Kenneth R. Arvedon, new field secretary of the National Tool and Die Manufacturers Association

KENNETH R. ARVEDON has been appointed field secretary of the National Tool and Die Manufacturers Association, with offices at 17 E. 42nd St., New York City. Mr. Arvedon will aid members of both the National Tool and Die Manufacturers Association and the New York Tool and Die Institute in the metropolitan area. He was previously executive secretary of Vesti (Veterans Employment Service of the Textile Industry).

CARBORUNDUM CO., Niagara Falls, N. Y., has recently established a marketing department under the direction of FREDERICK T. KEELER. The new department will bring together all related staff functions of marketing, including market research, advertising, sales promotion, and public relations. Mr. Keeler, who has been with the company since 1943, was director of commercial research prior to his present appointment. ARTHUR BATTS, JR., will be manager of the commercial research department; ARTHUR W. COWLES, advertising manager; LEWIS P. MERCER, manager of sales promotion; and E. DENT LACKEY, public relations manager. The offices of the new division will be located at the executive offices in Niagara Falls.

GENERAL ELECTRIC CO., Schenectady 5, N. Y., announces the following changes in the apparatus department: AB MARTIN has been made manager of the Fort Wayne, Ind., Works, succeeding C. H. MATSON, who has been named manufacturing consultant of the company's Small Apparatus Divisions staff.

LUPOMATIC INDUSTRIES, INC., 4510 Bullard Ave., New York 70, N. Y., manufacturer of tumbling equipment and compounds, announces that the name of the company has been changed to TUMB-L-MATIC, INC. The location remains the same.

L. A. WATTS has been appointed assistant general sales manager of the Wickwire Spencer Steel Division, Colorado Fuel & Iron Corporation, New York City. ROBERT H. WAGNER succeeds Mr. Watts as sales manager of the wire products department.

JOHN D. DICKINSON, formerly manager of locomotive sales of Lima-Hamilton Corporation, at New York, has been appointed assistant district manager of the New York district office of Baldwin-Lima-Hamilton Corporation.

ROBERT L. PETTIBONE has been made chief metallurgical engineer of the Sintercast Corporation of America, Yonkers, N. Y.

Members of the new marketing department of the Carborundum Co. (Seated, Left to Right) Arthur W. Cowles, advertising manager; Frederick T. Keeler, director of marketing; Lewis P. Mercer, promotion manager. (Standing) E. Dent Lackey, public relations manager; and Arthur Batts, Jr., manager of commercial research

Ohio

W. R. PERSONS was elected vice-president in charge of sales of the Lincoln Electric Co., Cleveland, Ohio, at a recent meeting of the board of directors. He was advanced to his new position from the post of general sales manager, which he has filled since 1946.

W. R. Persons, vice-president in charge of sales of Lincoln Electric Co.

WELLMAN ENGINEERING CO., Cleveland, Ohio, has purchased the business of the ANKER-HOLTH MFG. CO., Port Huron, Mich., manufacturer of hydraulic and air-operated cylinders, chucks and collets, as well as air valves and accessories. The newly organized business will be known as the ANKER-HOLTH DIVISION of the WELLMAN ENGINEERING CO. Headquarters of the division will remain in Port Huron, Mich., and J. C. HODGE, executive vice-president of the Wellman Engineering Co., will supervise the operation of the division. W. L. KOMPH will continue as manager of sales and engineering, and F. J. THEISEN as plant manager.

NORMAN F. SMITH, who has been vice-president and general manager of the Osborn Mfg. Co., Cleveland, Ohio, since 1938, was elected president of the company at the recent annual meeting of the board of directors. FRANKLIN G. SMITH, founder and former president of the company, was elected chairman of the board.

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MACHINERY'S DATA SHEETS 675 and 676

TYPICAL ALUMINUM CLEANING PRACTICES—1

Function	Grease, Oil, and Dirt Removal	
Process	Mild Alkaline Cleaning	Solvent and Vapor Degreasing
Comments	Economical and non-toxic	Uniform surface appearance Efficient oil and grease removal Step 1 or 2 will be sufficient in many applications
Step 1	Mild Alkaline Dip* 4 to 6 ounces cleaner per gallon of water 3 to 5 minutes at 160 to 190 degrees F.	Solvent Dip* 1 to 2 minutes in trichlorethylene at 160 to 188 degrees F. or perchlorethylene at 220 to 250 degrees F.
Step 2	Cold Water Rinse†	Vapor Rinse* Solvent temperature equals 200 to 250 degrees F.
Step 3	Dry	
Typical Proprietary Compounds	Oakite No. 61 Kelite No. 1 Sprex A. C. (DuBois Co.) DC No. 36 (Diversey Corporation) Agiton (Turco Products, Inc.) Clepo 86-P (Fred Gumm Chemical Co.) Triad B (Detrex Corporation)	Blacosolv (Turco Products, Inc.) Triad (Detrex Corporation) Permaclor (Detrex Corporation) Trichlorethylene or perchlorethylene (E. I. duPont Co.)

Note: Combinations of the above cleaning processes may be required, depending on the original surface condition of the metal.
*Steel tank with zinc-coated lining
†Wood or steel tank.

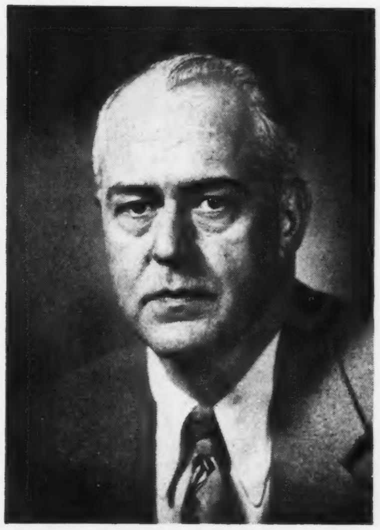
MACHINERY'S Data Sheet No. 675, February, 1951
Compiled by the Reynolds Metals Co.

TYPICAL ALUMINUM CLEANING PRACTICES—2

Function	Combined Cleaning and Etching	Oxide Removal: Heavy Oxide Removal	Oxide Removal: Light Oxide Removal
Process	Phosphoric Acid Type Cleaning	Alkaline Cleaning	Acidic Compound Cleaning
Comments	Provides phosphate coat which serves to increase paint adhesion Brush-on type solutions are also available	Provides uniform surface of low, constant electrical resistance suitable for resistance welding For aluminum alloys high in silicon, add 1 per cent hydrofluoric acid to nitric acid solution	Deoxidation obtained by room temperature process Provides uniform surface of low, constant electrical resistance suitable for resistance welding
Step 1	Acid Dip‡ One part acid solution to four parts water 1 to 2 minutes at 110 to 140 deg. F.	Alkaline Dip* 5 per cent caustic soda solution 1/2 to 1 minute at 140 to 160 deg. F.	Preclean Solvent or vapor degreasing
Step 2	Cold Water Rinse†	Cold Water Rinse†	Acidic Cleaner Dip‡ 12 to 16 ounces per gallon of water 3 to 5 minutes at room temperature
Step 3	Dry	Acid Dip‡ 20 to 50 per cent nitric acid solution 1/2 to 1 minute at room temperature	Cold Water Rinse†
Step 4		Cold Water Rinse†	Dry
Step 5		Dry	
Typical Proprietary Compounds	Oakite No. 36 Diversey No. 3 W.O. No. 1 (Turco Products, Inc.)	Oakite No. 30 Diversey No. 30 Kelite No. 33	Oakite No. 34 LAC 2589 (Turco Products, Inc.) Clepo No. 1805 (Fred Gumm Chemical Co.)

Note: Combinations of the above cleaning processes may be required, depending on the original surface condition of the metal.
*Steel tank
†Wood or steel tank
‡Stainless or acid-resistant lined tank

MACHINERY'S Data Sheet No. 676, February, 1951
Compiled by the Reynolds Metals Co.



(Left) Dwight A. Bessmer, recently appointed assistant to the president of the Timken Roller Bearing Co. (Right) Paul E. Young, new director of purchases

Dwight A. Bessmer, director of purchases of the Timken Roller Bearing Co., Canton, Ohio, has been appointed assistant to the president. He will be succeeded in his former position by Paul E. Young. R. J. Archibald becomes assistant general purchasing agent.

Wilbur E. Crink has been appointed chief engineer of the Addressograph-Multigraph Corporation, Cleveland, Ohio. Mr. Crink has been with the company for four years and has served as product engineer since June, 1948. He will be succeeded in the latter position by Robert H. Lease.

General Electric Co., Schenectady 6, N. Y., has announced that a vast aircraft jet-engine and turbo-prop test, development, and production center will be established at Lockland, Ohio, near Cincinnati, to meet increased military needs for G-E engines.

Paul A. Miller has been elected to the newly created position of vice-president in charge of manufacturing of the Leece-Neville Co., Cleveland, Ohio. Mr. Miller has been factory manager since the end of the last war.

Charles E. Newman has been appointed sales engineer in the Chicago territory for the Surface Combustion Corporation, Toledo, Ohio.

Pennsylvania

Leeds & Northrup Co., Philadelphia, Pa., manufacturer of electrical measuring instruments, automatic controls, and heat-treating furnaces, announces that it has acquired approximately 85,000 square feet of additional floor space, which will enable the company to increase production and improve its delivery and other service facilities. Some operations will be transferred to the new quarters, but the principal manufacturing and other activities of the firm will continue to be centered at the main plant at 4901 Stenton Ave. The increased facilities consist of a three-story building at Castor and Sedgley Aves., Philadelphia, containing 50,000 square feet of floor space, and a building at Collum and Rubicam Sts., Germantown, which will provide an additional 35,000 square feet of floor space.

Edward J. Hanley was elected president of the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa., at a recent meeting of the board of directors. Mr. Hanley, who has been serving as executive vice-president, succeeds E. B. Cleborne, whose resignation was recently announced. At the same meeting, Clark W. King was elected executive vice-president. Announcement was also made of the retirement of Frank B. Lounsberry as vice-president and technical director, and the appointment of W. B. Pierce, now serving as manager of the company's sales development and engineering service department, to the post of technical director.

Townsend Co., New Brighton, Pa., and the Cherry Rivet Co., Los Angeles, Calif., have announced a merger of the two rivet companies. Under the new organization, the West Coast plant will operate as the Cherry Rivet Co., Division of Townsend Co. William B. Hubbard, former president of the Cherry Rivet Co., will be managing director of the Cherry Rivet Division, and has been elected a member of the Townsend board of directors.

H. C. Coleman has been appointed manager of the industry engineering departments of the Westinghouse Electric Corporation, with headquarters at East Pittsburgh. He succeeds F. R. Benedict, who was recently assigned new duties with the company's Atomic Power Division. S. A. Haverstick takes Mr. Coleman's former position as manager of the marine and aviation section of the industry engineering departments of the company.

Casimir S. Kopec has joined the American Gear Manufacturers Association, Pittsburgh, Pa., as staff engineer. He will devote his time to the development of the Association's technical literature. Practically all of Mr. Kopec's business career has

Edward J. Hanley, newly elected president of the Allegheny Ludlum Steel Corporation

Casimir S. Kopec, new staff engineer with American Gear Manufacturers Association

been spent with the General Motors Corporation's and the Ford Motor Co.'s research laboratories, specializing in gear design.

SKF Industries, Inc., Philadelphia, Pa., announces that it is placing in production ball and roller bearings that will be marketed in the United States and foreign countries under the trademark "Hess-Bright." The principal reason for the adoption of this trademark, it is stated, is to clarify the nature of the company's export operations under the anti-trust laws. Ball and roller bearings will continue to be sold to the domestic trade under the SKF trademark. Richard H. DeMott, new president of the company, has recently been elected a member of the board of directors of the Anti-Friction Bearing Manufacturers Association. He is chairman of the Association's defense committee.

Edward J. Lilly has recently been appointed sales engineer for the Butterfield Division, Union Twist Drill Co., manufacturer of taps, dies, reamers, and special metal-cutting tools. He will represent the Division in the Philadelphia and Baltimore areas, with headquarters in Philadelphia. Mr. Lilly was formerly associated with the Simonds Abrasive Co.

SKF Industries, Inc., Philadelphia, Pa., announces the following recent appointments: Gunnar Palmgren, assistant vice-president; and Arthur S. Roberts, general counsel. Mr. Palmgren also serves as chief engineer, a post he has held since 1934. Jack R. Bremer has been named assistant purchasing agent.

H. Thomas Hallowell, Jr., has been elected president of the Standard Pressed Steel Co., Jenkintown, Pa., manufacturer of socket screw products, lock-nuts, and pressed-steel shop equipment. He succeeds H. T. Hallowell, Sr., founder of the company, who becomes chairman of the board. Harold F. Gade, co-founder of the company and present treasurer, has been given the additional title of senior vice-president. J. Whiting Friel has been advanced from sales manager to vice-president in charge of sales; and William I. Kryder has been made secretary, succeeding Ralph S. Mast, who has retired after forty-six years of service with the company.

L. W. Jander has been made sales manager of the Industrial Division of Henry Disston & Sons, Inc., Philadelphia, Pa., manufacturer of saws, tools, files, and special steels. He succeeds J. F. Wilkinson, who has resigned to enter his own industrial distributing business in Miami, Fla.

L. V. Johnson has been promoted from the position of assistant chief engineer to chief engineer of the National Tube Co., Pittsburgh, Pa. He will assume the duties of John L. Young, who has been elected vice-president and chief engineer of the newly formed United States Steel Co.

Emil R. Schaeffer has been made manager of manufacturing of the Switchgear Divisions of the General Electric Co. at Philadelphia, Pa. He was formerly assistant to the manager of manufacturing.

Wisconsin

Edgar L. McFerren has been made chief engineer of the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., succeeding K. F. Gallimore, who will continue as a director, vice-president, and consulting engineer of the company. Fred C. Freund takes Mr. McFerren's former post as assistant works manager. Ray G. Commo has been promoted to the position of supervisor of personnel, and will head the industrial relations department.

Alphons J. John has been named head of a newly created employe-public relations office of the Kearney & Trecker Corporation, Milwaukee, Wis. Mr. John has been advertising director of the company since 1946, and will also continue to serve in that capacity.

(Left) H. Thomas Hallowell, Jr., new president of Standard Pressed Steel Co.
(Right) J. Whiting Friel, vice-president in charge of sales

Obituaries

Newton A. Woodworth

Newton A. Woodworth, founder of the Ex-Cell-O Corporation, Detroit, Mich., and of the N. A. Woodworth Co., Ferndale, Mich., died on December 27 at the Henry Ford Hospital, where he had been in semi-retirement since the end of World War II. Mr. Woodworth was a native of Fort Wayne, Ind., and graduated from the Ohio Northern University in 1915. He began his manufacturing career with the Ford Motor Co., starting in the tool-room and later establishing and managing the company's aircraft plant.

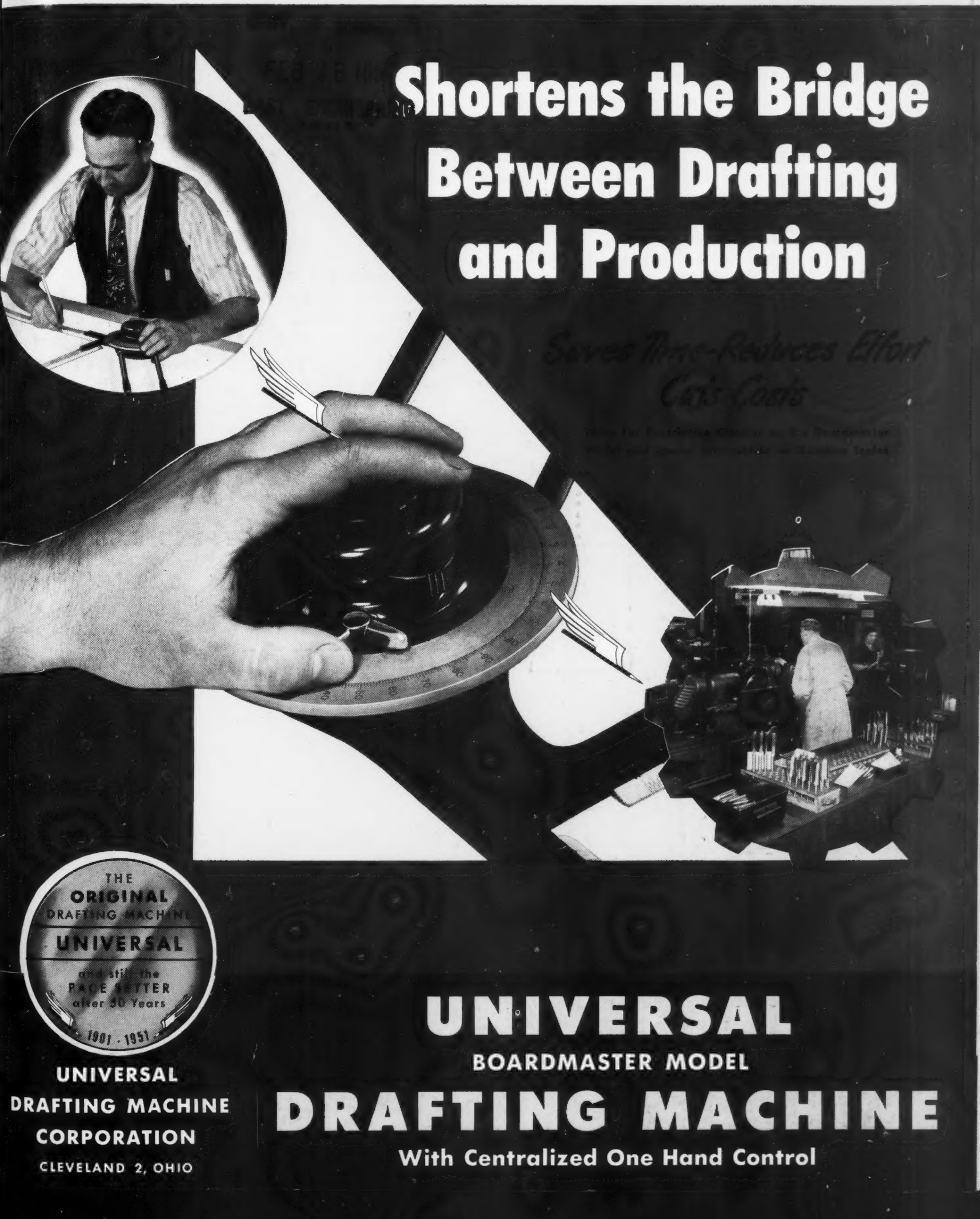
In 1919, he founded the Ex-Cell-O Corporation for producing precision tools and parts, and remained president of that company until 1937, when he retired. In 1939, he returned to the precision parts manufacturing field, establishing the N. A. Woodworth Co. Starting with twenty-five employes, the working force grew to 6000. During World War II the company was a large producer of aircraft engine parts. Mr. Woodworth is survived by his wife and one daughter.

Harry V. Snyder

Harry V. Snyder, factory manager of the Manhattan Rubber Division, Raybestos-Manhattan, Inc., Passaic, N. J., died suddenly on December 2 at the Point Pleasant Hospital, Point Pleasant, N. J., aged fifty-six years. Mr. Snyder had been connected with the Manhattan Rubber Division since 1909, starting in the billing department. As the company expanded, he became successively head of various departments. For over twenty-five years, he was manager of the roll covering and tank lining departments. In 1942, he became assistant factory manager, and was promoted to the position of factory manager in 1944.

FEBRUARY 1951 — FIFTY-SEVENTH YEAR

MACHINERY



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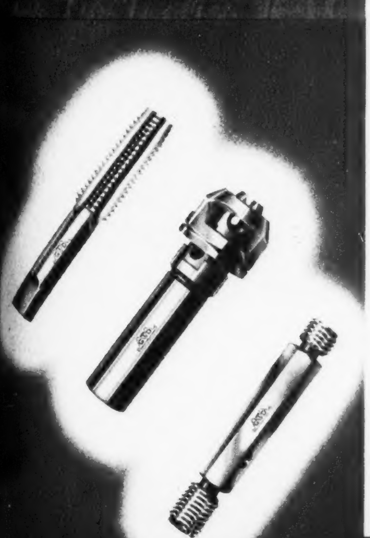

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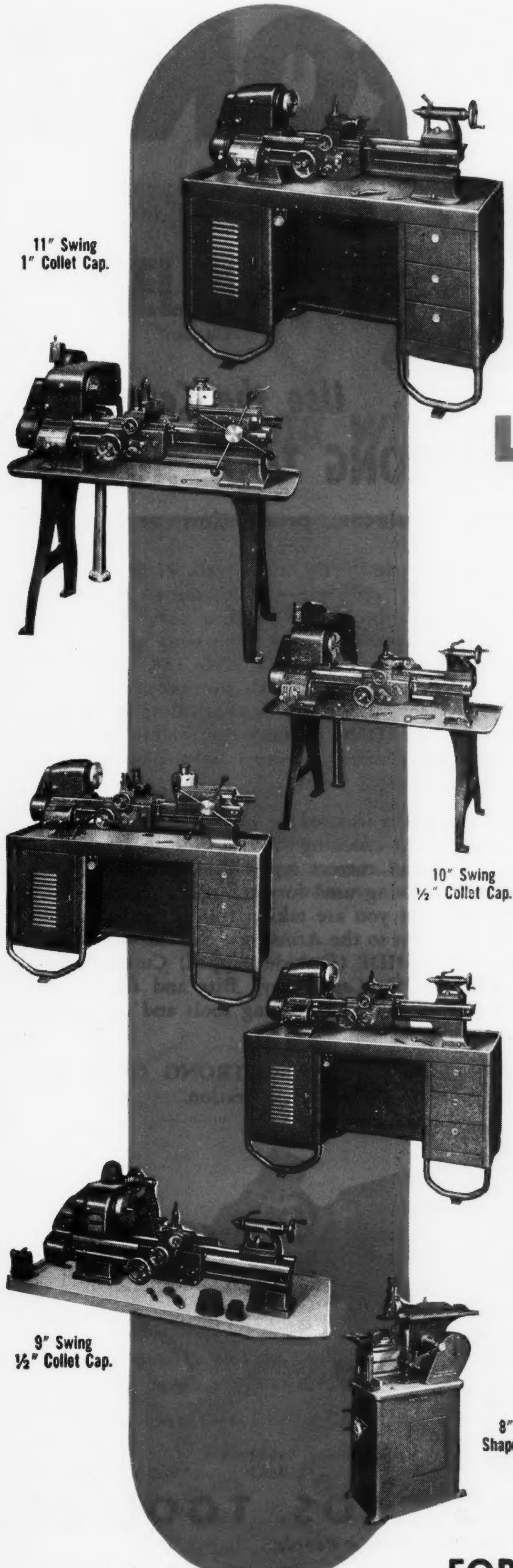


YOU CAN MAKE IT **ACCURATE**

YOU CAN MAKE IT . . . . **FAST**

YOU CAN MAKE IT **FOR LESS**

ON A

LOGAN LATHE

The accuracy inherent in advanced Logan Lathe design permits holding precision tolerances on the production line as well as in the tool room. In large or small shops, wherever the need is for accelerated, accurate parts production and low cost operation, Logan Lathes can provide a practical, profitable solution. 45 accurate, versatile Logan Lathe models, 9", 10" and 11" swing, ½" and 1" collet capacity, plus a complete line of lathe accessories assure year-in, year-out dependability. For full details on Logan Lathes and on the Logan 8" Shaper, see your Logan Lathe dealer, or write to

LOGAN ENGINEERING CO.
4901 West Lawrence Avenue • Chicago 30, Illinois

LOOK TO Logan

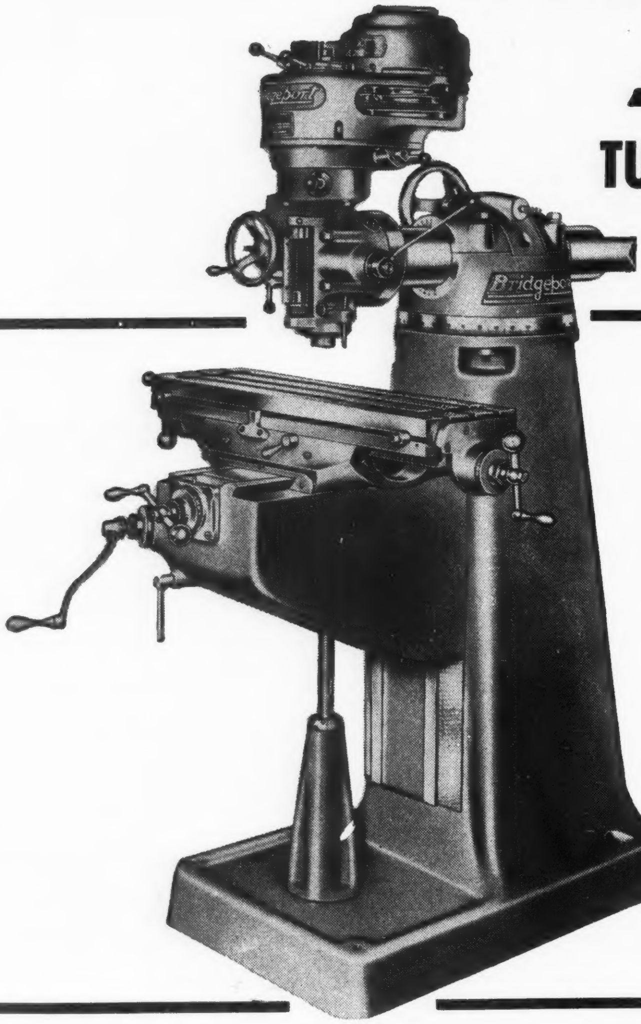
FOR *BETTER* LATHES and SHAPERS

A PREDICTION for 1951:

Bridgeport

TURRET MILLING MACHINES

will continue to win ever-widening acceptance

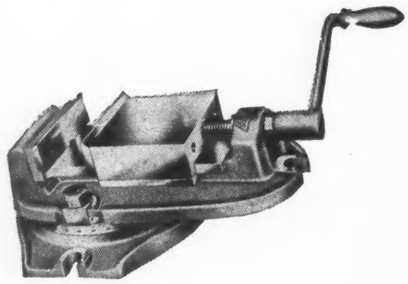


More than 12,000 are in service today

Since announcing the new Bridgeport 1 HP Head less than two years ago, these higher capacity machines with their recently developed attachments have been moving into metal working shops in a constant stream. Tool rooms, die shops and production lines are taking advantage of the greater versatility, capacity and convenience available to speed up the handling of larger, more difficult work.

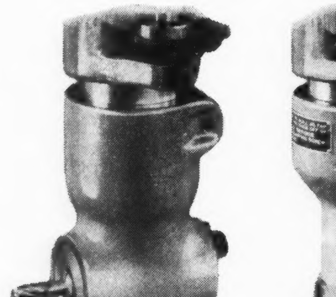
Bridgeport Attachments are adaptable to machines already in service as well as to the higher capacity, 1 HP Head, thereby making it possible to increase the productivity of "Bridgeports" wherever it is desired to do so.

It will be to your advantage to ask for more detailed information.



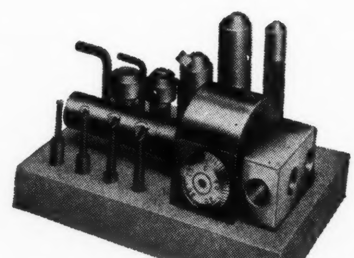
MILLING MACHINE VISE

This improved vise provides greater gripping power. It is streamlined for attractive appearance and furnished with a large diameter screw for rigid holding. A coolant trough is provided. Made in two sizes: 5"x3½" and 6"x5" jaw openings.



RIGHT ANGLE ATTACHMENTS

Available in two types: Heavy duty (left) and light duty (right). The heavy duty attachment is made in two sizes and will mill and drill at right angles. It fits both the Master and the 1 HP Bridgeport Heads. The light duty type is designed for milling and drilling of narrow, deep molds and cavities.



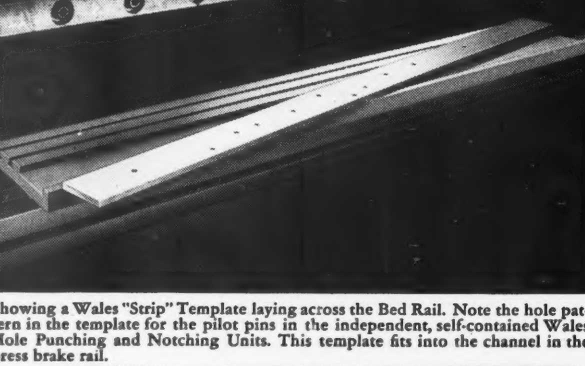
NO. 2 BORING HEAD

Boring tools and holder make this attachment capable of boring holes up to 6" diameter. It is available for use on the Bridgeport 1 HP Milling, Drilling and Boring Attachment.

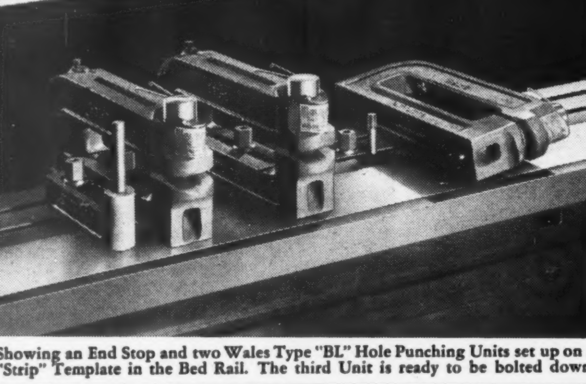
Bridgeport MACHINES, INC.

Bridgeport, Connecticut

Manufacturers of High Speed Milling Attachments and Turret Milling Machines



Showing a Wales "Strip" Template laying across the Bed Rail. Note the hole pattern in the template for the pilot pins in the independent, self-contained Wales Hole Punching and Notching Units. This template fits into the channel in the press brake rail.



Showing an End Stop and two Wales Type "BL" Hole Punching Units set up on a "Strip" Template in the Bed Rail. The third Unit is ready to be bolted down.

You don't need expensive die sets with

WALES

HOLE PUNCHING & NOTCHING UNITS

A Typical hole punching set-up ready to operate. *Note the elimination of expensive die sets.*

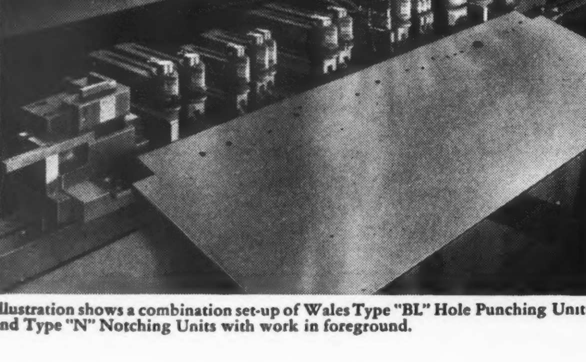


Illustration shows a combination set-up of Wales Type "BL" Hole Punching Units and Type "N" Notching Units with work in foreground.

● The exclusive Wales "Strip" Template Mounting Method for press brakes provides faster set-ups, reduced press "down-time" and easier storage of templates,— all *without the use of die sets.*

As shown at the left, this Mounting Method is made in 2 parts — (1) the Bed Rail and (2) the "Strip" Templates that fit into the bed rail channel. In this way, the Bed Rail remains in the press and the "Strip" Templates are interchanged for unlimited set-ups.

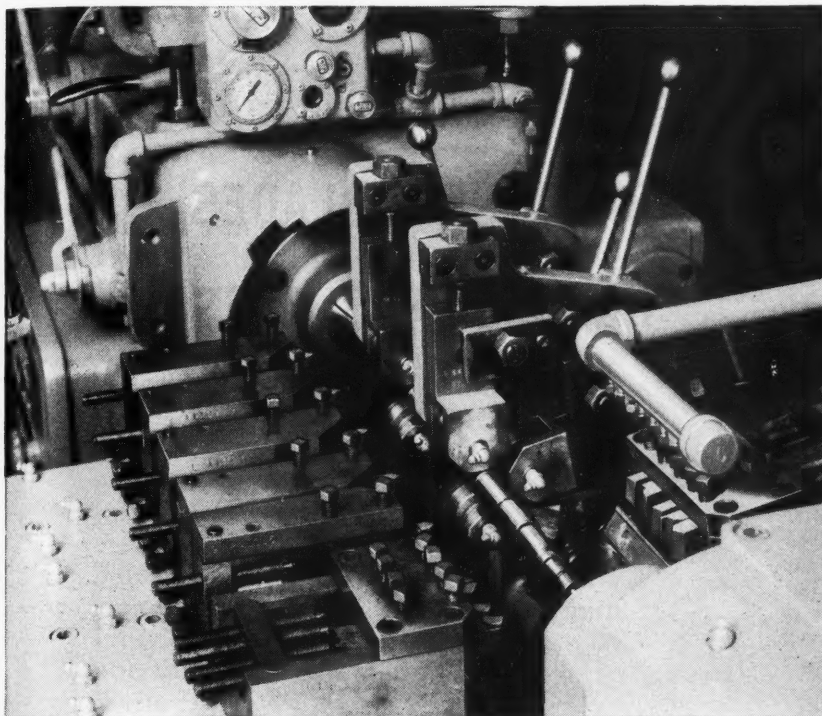
The hole locations are drilled and reamed in the "Strip" Templates for the pilot pins that are concentric with the punches and dies in all Wales independent, self-contained Units. In many cases, holes for several set-ups may be drilled in one "Strip" Template. The press ram does not have to be adjusted between set-ups due to the uniform shut height of Wales Hole Punching and Notching Units. In addition, the same group of Units may be used on an unlimited number of "Strip" Templates.

THE MULTIPLE SAVINGS IN TIME AND INVESTMENT with Wales Equipment is too BIG a story to tell in this space, so write for fully-illustrated, functionally-colored Catalog BL and Catalog N *today.*

WALES-STRIPPIT CORPORATION
GEORGE F. WALES, *Chairman*
375 PAYNE AVE., NORTH TONAWANDA, N. Y.
(Between Buffalo and Niagara Falls)
WALES-STRIPPIT OF CANADA, LTD., HAMILTON, ONTARIO
Specialists in Punching and Notching Equipment

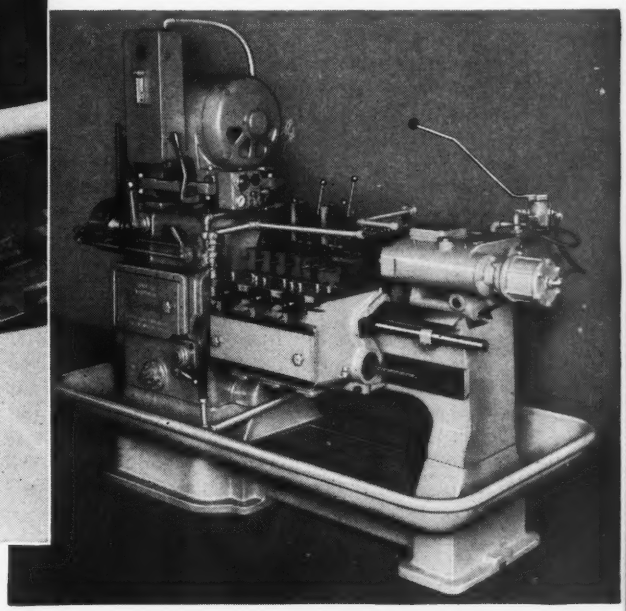
MACHINE OF THE MONTH

PREPARED BY THE SENECA FALLS MACHINE CO. "THE Lo-swing PEOPLE" SENECA FALLS, NEW YORK



Left: Closeup view of tooling and steady rests.

Below: Model LR Lo-swing Lathe equipped for machining spinning rolls.



MODEL LR Lo-swing LATHE SPEEDS SPINNING ROLL PRODUCTION

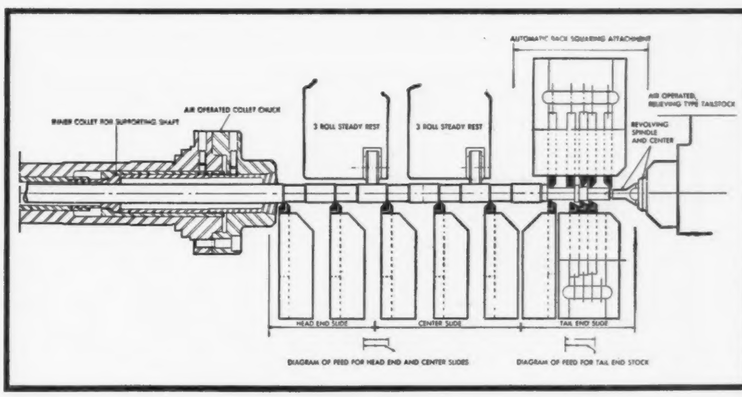
Problem: To turn and face long spinning rolls within close tolerances.

Solution: The Model LR Automatic Lo-swing Lathe selected for this job was equipped with a hollow spindle to permit one-half of the spinning roll to extend into the spindle. This method increased the rigidity of the work and assured closer machining tolerances. The upper right illustration shows the lathe equipped for the first turning operation. Note the relieving type tailstock which swings on hinged joints to facilitate loading work into the collet chuck. The upper left illustration is a closeup view of the tooling and steady rests.

The spinning rolls are turned from ground stock, properly centered on each end. They are supported by the collet chuck, two 3-roll rests, and a tailstock center, as shown in the tooling layout below. This method holds the work very rigidly and assures the close tolerances specified on the turned diameters.

The entire operation is automatic; the operator simply places the roll in position and locks the steady rests on the previously ground bar stock. The machine cycle is then started and continues automatically until all diameters are turned and faced, and the tool slides returned to the starting position. A similar machine and tooling is used for machining the opposite end of the shaft.

Let Seneca Falls engineers assist you with your turning problems.



SENECA FALLS MACHINE CO., SENECA FALLS, N. Y.

PRODUCTION COSTS ARE LOWER WITH Lo-swing

Only MARVEL *builds all four**

While it is true there are several builders of hack sawing machines and many builders of band sawing machines, only MARVEL builds **BOTH** hack saws and band saws. The fact is that MARVEL manufactures 35 models of 10 basic types of metal sawing machines which include the world's fastest automatic production saw, the world's largest giant hydraulic hack saws, the world's most versatile band saw and the most widely used small shop saws.

With intimate and broad field experience in all types of metal cutting-off equipment and 35 different saws available, it is obvious that MARVEL Field Engineers occupy a unique and exclusive position in the industry. They are eminently qualified to make expert and **unbiased** recommendations covering the type, size and model of metal sawing equipment best suited to individual requirements — the most efficient, most accurate, fastest, broadest in scope and the most economical.

MARVEL is also the only manufacturer of both metal sawing **machines** and metal sawing **blades.** Because the efficiencies of both the machine and the blades are interdependent, each upon the capability of the other, expert knowledge covering both saws and saw blades is essential to the proper appraisal of any specific sawing situation. Correct balance of cutting speed and blade life, feed pressure and blade tension are all potent factors in over-all performance. Here again it is the MARVEL Field Engineer who is qualified to provide the comprehensive answer to your question. His job is to help you saw metal most efficiently—his services are available upon request—gratis.

Write for Catalog 49

ARMSTRONG-BLUM MFG. CO.
5700 BLOOMINGDALE AVE., CHICAGO 39, U.S.A.

*HACK SAWING MACHINES
*BAND SAWING MACHINES
*BAND SAW BLADES
*HACK SAW BLADES

Four pieces DRILLED . . . FACED . . . CHAMFERED . . . TAPPED

EVERY 20 SECONDS!

BAKER
HYDRAULIC MACHINE

One of a multitude of possible applications for the Baker 15 x 16 Hydraulic Unit is this new Baker single end horizontal trunnion type indexing machine with 7 stations, which is capable of an estimated hourly production of 652 pieces at 100% efficiency. Operations include drilling, facing, chamfering and tapping. Chutes are provided (see arrow) for the parts which are automatically ejected from the fixture into conveyances. The new Baker features automatic clamping by hydraulics, tapping with individual leadscrew tapper and outside portable hydraulic pump sump unit. Write Baker regarding your specific job problems.

AUTOMATIC PART EJECTION CHUTE PLACES FINISHED PARTS IN CONVEYANCE

BAKER BROTHERS, INC., Toledo, Ohio
DRILLING, TAPPING, KEYSEATING and CONTOUR GRINDING MACHINES

WANTED

P-K
TRADE MARK
REG. U.S. PAT. OFF.

for more of industry's finest products than ever before

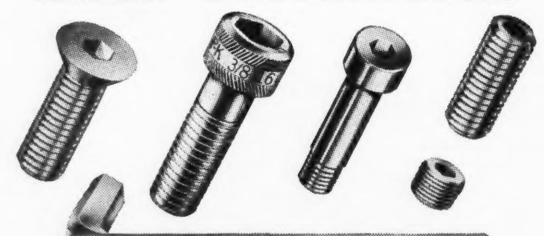
Most products assembled with Socket Screws are engineered to meet demands for efficiency and endurance well above common standards.

To make sure of fastenings equal in quality to other components, more manufacturers are specifying Parker-Kalon Socket Screws than ever before. The reasons are clear.

Just look at a P-K* Ground Thread Socket Set Screw, for example. You can see and feel the difference. By any standard of comparison, no finer screws are made. And the P-K Quality-Control makes sure that every screw in every box meets specifications.

P-K production is going all-out to meet this mounting demand. For D.O. or other assemblies, set your standards by P-K quality. Parker-Kalon Corporation, 202 Varick St., New York 14, N. Y.

FOR ANY TYPE OF SOCKET SCREW
REMEMBER—IF IT'S P-K . . . IT'S O.K.*



Flat Head Socket Cap Screws • Size-marked Socket Head Cap Screws
Stripper Bolts • Ground Thread Socket Set Screws • Pipe Plugs • Hex Keys
Available Through Accredited Distributors.

**Trade Marks Reg. U. S. Pat. Off.*

PARKER-KALON*
cold-forged
SOCKET SCREWS

Wade®

No. 7

HAND SCREW MACHINE

. . . for modern, fast, economical production of second-operation work. All rotating parts are "Dynetrically" balanced for vibrationless operation at all speeds. Quick-acting collet closer allows swift and almost effortless chucking and removal of work.

7" swing Spindle speeds, 315 to 3300 RPM
1" collet with superior characteristics
4-to-1 Hi-Lo Speeds at finger tips
Spindle stops without stopping motor

Send for Catalog

THE WADE TOOL CO., 52 River St., Waltham, Mass.